

DENTAL BITES

Volume 11 issue 4 | October - December 2024

**PERIODONTICS, PUBLIC HEALTH
DENTISTRY AND IMPLANTOLOGY**



a quarterly publication of



KMCT
DENTAL COLLEGE



KMCT Medical College Campus, Mukkom, Kozhikode - 673 602

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INNOVATION AND
ENTREPRENEURSHIP
DEVELOPMENT CENTRE



KMCT Medical College Campus, Mukkom, Kozhikode - 673 602

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Editorial

Dear Readers,

It gives me immense pleasure to introduce this special issue of the KMCT Dental College Journal, which highlights the significance of Public Health Dentistry in addressing the oral health needs of diverse populations, particularly the marginalized and underserved communities.

At KMCT Dental College, the Department of Public Health Dentistry has been actively conducting numerous outreach programs, dental camps, and awareness initiatives to ensure that quality oral healthcare reaches every segment of society. Through school dental health programs, community camps, and collaborations with governmental and non-governmental organizations, our institution is playing a pivotal role in improving oral health awareness and preventive care.

A milestone achievement for us this year has been the introduction of the MDS program in Public Health Dentistry. This marks a new chapter in our commitment to advancing community dentistry and training future professionals who will serve as advocates for public health at both local and national levels. The scope of community dentistry extends beyond clinical practice—it encompasses epidemiological research, health policy planning, tobacco cessation initiatives, and the integration of oral health with general health. With increasing government and global focus on preventive healthcare, the demand for trained public health dentists is growing, offering vast career opportunities in academics, research, healthcare administration, and international health organizations.

To aspiring students considering a career in Public Health Dentistry, I encourage you to embrace this field with passion and dedication. It is a domain where your expertise can make a tangible difference in society, bridging the gap between healthcare access and equity. We look forward to welcoming the next cohort of postgraduate students who are committed to making a lasting impact in the field of public health.

Let us continue to strive for excellence in community service and academic endeavors, ensuring that our institution remains at the forefront of dental education and public health initiatives.

With warm regards,

Dr Manoj Kumar K.P
Principal

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Perceived level of competency of Dental graduates of a dental teaching institution in Kerala: A cross sectional survey

*Aromal, **Dhanya Muralidharan, ***Arun Paul.

Abstract

Aim: To determine the level of competency among dental graduates of a dental teaching institution at Kozhikode, Kerala.

Methodology: A cross sectional survey was initiated among the dental graduates of a dental teaching institute at Kozhikode, Kerala using convenience sampling method. A questionnaire was used as a measuring tool to evaluate the level of competency among the dental graduates. The data obtained under the study were analysed using IBM Statistics version 20. Chi square test was used to assess the difference obtained in the data observed for statistical significance less than 0.05 from the study sample.

Result: The present study revealed that among the 76 dental graduates of the institution, majority of them were confident enough in various practical skills like taking and interpreting radiographs, diagnosing pre and malignant lesions, identifying cases of malocclusion. The level of competency among the study sample were considered to be high in procedures like performing root canal treatment in anterior teeth. While a considerate amount of study participants, suggested that they would like more practical training in selected procedures during the undergraduate program.

Conclusion: The study concluded that even though the perceived competency level among the dental graduates were high in terms of research and dental practical skills, a significant number of dental graduates lacked competency in specific areas suggesting need for additional training and workshops to overcome their limitations.

Key Words; *level of competency, dental graduate, teaching institution, Kerala, perception*

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Introduction

India is claimed to be the second country to have the highest no of dentists with around three lakh dentists registered under the dental council of India. The dentists of India are over populated than the recommended dentist to population ratio of 1:7500, to 1:10,000.² The profession has boomed to such an extent that, the number of job opportunities are insufficient to balance the number of dentist passing out each year. The solution to this problem lies in the deficiency of various public institutions, distribution of the dentists and oral health access.¹ Only around sixty registered government dental colleges are present while there are more number of private colleges educating dental graduates. This concern about the profession has marched among the young budding dental interns of various dental colleges who are confused and worried about their future with less job opportunities and less pay scale for fresh graduates. There exists an imbalance between dental job openings and the number of dental graduates which creates a difficult niche for dentists to persist within the dental profession.

The next step after pursuing BDS has always been a question and helpless situation for most of all the dental graduates. Currently dental graduates who are knowledgeable and have adequate practical skills get good job opportunities and better dental practise while majority of the graduates still pool around without proper advancement in their career. Because of this situation the dental graduates compete among each other for their professional existence. However this situation has eventually created a niche to evaluate the level of competency of the dental graduate for their professional skills. Hence outcome of dental teaching program at various institutions should be such that level of theoretical knowledge and practical skills produce competent dental graduates.²

According to the Dental Council of India, dental graduates should excel in attributes such as knowledge and practical skill, develop an attitude towards carrying out various activities to practise dentistry such as diagnosing and treating diseases of teeth and associated tissues in the mouth.³ Presently the level of competency of a dental graduate according to the standard goals and objectives declared by the dental

council of India is less known. Since there exists a dearth in research exploring the perception regarding the level of competency of the dental graduates, a cross sectional survey was proposed among the dental interns at a dental teaching institution in Kozhikode, Kerala to determine their perceived competency following undergraduate training program.

Materials and method

The design of the study was a descriptive cross sectional survey , conducted during the period August – September 2024 through online google forms to collect data from the study subjects who were the dental interns of a dental teaching institution at Kozhikode. Only responses of interns who were completing their internship period within September 2024 were included in the present study. The study questionnaire was distributed to the dental interns through WhatsApp alumni groups of the institution. Consent was obtained from the study subjects, and consenting to participate in

the study gradually guided them to fill the questionnaire to assess their perception on the level of competency in the field of dentistry. The questionnaire consisted of two sections. The first section collected data regarding the sociodemographic details of the study samples and the second section consisted of questions to assess the level of competency. Care was taken to include only one response from each study sample to avoid data duplication which was done through google form settings. Responses which had incomplete data entry were excluded in the study.

Statistical analysis: The data collected were tabulated in Microsoft Excel and further analysis were done using SPSS version 20. The quantitative variables were expressed as mean, standard deviation and qualitative variables were expressed as percentages. The data were analysed using Chi square test to assess its significance. The data were considered significant if obtained a p value less than 0.05.

Result

The current study when conducted , obtained 76 responses within a period of 1 month from dental interns and graduates of a dental teaching institution at Kozhikode, Kerala. The study population composed of 62 (81.6%) females and 14 (18.4%) males with a mean age of 25.48 ± 1.11 . Among them, 37 (48.7%) of them will complete their internship during 2024-2025 period, 31 (40.8%) of them completed their internship during 2023-2024 and 8 (10.5%) of them completed during 2022-2023. The demographic details of the study population resulted

that, majority of the parents of the study subjects were not dentists 75 (98.7%) and 55(72.4%) of them were not government employees among which many were not even graduates 25 (32.9%). (Table: 1) (Table: 2)

Table 1: Demographic details of the study population

Variable	N = 76
Age (Mean $\pm$ SD)	25.48 $\pm$ 1.11
Male n (%)	14 (18.4%)
Female n (%)	62 (81.6%)

Table 2: Demographic profile of the parents of the study participants

Variable	n (%)	p value
Parents occupation		
Either one of them is a dentist	1 (1.3%)	< 0.001*
Both are not dentists	75 (98.7%)	
Parents employment		
Both are Government employees	6 (7.9%)	< 0.001*
Either one of them is a Government employee	15(19.7%)	
Both are not Government employee	55 (72.4%)	
Parents Education		
Both are Post graduates	4 (5.3%)	< 0.001*
Both are Graduates	18 (23.7%)	
Both are not Graduates	25 (32.9%)	
One parent is Post graduate and other Graduate	8 (10.5%)	
One parent is Post graduate and other Not Graduate	6 (7.9%)	
One parent is Graduate and other Not Graduate	15 (19.7%)	

*Statistically significant

On assessing their primary interest after graduation, the study population were more inclined towards a general dentistry practise 32 (42.1%) followed by being an academician and a clinician 28(36.8%). Among the study subjects 31(40.8%) of them were interested to join postgraduation and most of them 30 (39.5%) chose orthodontics as their prime interested speciality.

Among the 76 study subjects, only 7(9.2%) of them had undertaken a research project during their degree course and 5(6.6%) of them admitted to be very confident in conducting research. (Table : 3)

Table 3: Perceived competency of dental graduates towards research

Question	n (%)	p value
Have you undertaken a research project during BDS course		
Yes	7 (9.2%)	< 0.001*
No	69 (90.8%)	
How confident are you in conducting research?		
Very Confident	24 (31.6%)	< 0.001*
Confident	50 (65.8%)	
Not Confident	2 (2.6%)	

*Statistically significant

On assessing the dental graduates regarding their dental practise skill, majority of them were confident 50 (65.8%) while 24(31.6%) of them were very confident to start dental practise just after graduation. It was observed among the dental interns under the current study that, majority of them 35 (46.1%) were motivated about pursuing dentistry due to the flexible working environment. On assessing the teaching efficiency and dental training of the teaching institute, it was evident that majority of them 68 (89.5%) responded as they are confident enough to take radiograph for a tooth, 70 (92.1%) could interpret dental radiographs, 40 (52.6%) of the study population could diagnose oral malignant and pre malignant condition and 71(93.4%) of them could diagnose the condition malocclusion. When evaluating the skills of dental graduates of the institution, it was observed that 69 (90.8%) of the dental graduates were trained and confident in doing root canal treatment in single rooted teeth and 15 (19.7%) of them were self assured in doing on multi rooted teeth. 36 (47.4%) believed that they could manage specially challenged individuals in dental treatments. (Table:4)

Table: 4 Perceived competency of dental graduates towards dental practise

Question	Yes n (%)	No n (%)	p value
Confident enough to take radiograph for a tooth	68 (89.5%)	8 (10.5%)	< 0.001*
Confident enough to interpret dental radiograph	70 (92.1%)	6 (7.9%)	< 0.001*
Confident enough in diagnosing oral malignant and premalignant lesions	40 (52.6%)	36 (47.4%)	0.646
Confident enough in doing root canal treatment in single rooted tooth	69 (90.8%)	7 (9.2%)	< 0.001*
Confident enough in doing root canal treatment in multi rooted tooth	15 (19.7%)	61 (80.3%)	< 0.001*
Confident enough in managing specially challenged individuals	36 (47.4%)	40 (52.6%)	0.646
Confident enough in diagnosing malocclusion	71 (93.4%)	5 (6.6%)	< 0.001*

*Statistically significant

The dental graduates responded to the observation which questioned the procedure which needed more training exposure as, 17 (22.4%) felt training in all types of extractions were needed, 9 (11.8%) of them wanted exposure in fabricating and activating orthodontic appliances and 7 (9.2%) of them felt that training exposure lacked in repairing both complete and removable partial dentures. On assessing the endodontic training in the institute, a proportion of 3 (3.9%) of them claimed they required more restorative training. A fraction of 5 (6.6%) of the dental interns suggested that their exposure in doing tooth preparation and crown placement was insufficient. Among the study participants majority 35(46.1%) of the dental interns claimed that they needed more exposure in multiple procedures during their undergraduation course. (TABLE: 5)

Table 5: Response from the dental graduates about the dental procedures which lacked training exposure

Procedures	n (%)	p value
Fabricating and repairing of complete and removable partial denture	7 (9.2%)	< 0.001*
All kinds of restorations	3 (3.9%)	
Tooth preparation and crown placement	5 (6.6%)	

All types of extractions	17 (22.4%)	
Fabricating and activating ortho appliances	9 (11.8%)	
Combination of procedures	35 (46.1%)	

*Statistically significant

Discussion

The current study comprised of majority of the dental graduates who completed their internship during 2023-2024 time period. The study population highlighted a female dominant trait of 81.6% compared to males composed of 18.4%. On evaluating the demographic details of the dental graduates, it was found that majority (98.7%) of their parents were not dental professionals. This finding in the study stood contrast with a study done by Karibe et al in 2009 ⁴ which stated that nearly 60% of the Japanese dental students had either of their parent as a dentist such that the graduates found handling difficult situation in ease. The lack of parents as dentists who could provide a familiar working environment or guidance, causes young budding dentists to be concerned about their future options. It can also be interpreted that the study participants relied on the teaching institution alone for moulding their profession. Majority of the parents of the study respondents, were not graduates (32.9%) followed by those who were graduates and additionally a very few proportion (7.9%) among the parents serve under the government.

On evaluation, majority of them 31 (40.8%) chose postgraduation as their future plan just after graduation and orthodontics was the most common speciality of interest chosen by the graduates. In contrast to the obtained finding, a similar study done by Halawany HS in 2014 ⁵ at Saudi Arabia revealed that oral and maxillofacial surgery and operative dentistry were the most preferred specialities among the males and females in the study respectively. On the other hand, 15 (19.7%) of the dental interns wants to work at a private clinic and upgrade their clinical practise. A noticeable finding was that, an equivalent number of them 16 (21.1%) expressed their desire to move abroad to study. A similar finding was observed in a study done by Amit Aggarwal et al in 2012 ⁶ which showed 66.9% of the study participants wished to go abroad for their future dental enhancement. Very importantly, most of the study subjects claimed that they chose dentistry due to flexible working environment. This could be due to the gender composition of the study population to be more of females compared to males.

It was evident that, research was less explored by the study subjects while, majority of them expressed that they are confident enough in conducting research. This observation could be due to the fact that research training provided by the institution is less utilised by the students during their learning period at the institution. It can be interpreted that the dental interns were not aware of the scope of research which can uplift both their research and career options.

On evaluating self perceived competency in taking radiographs and diagnosing oral malignant lesions majority of the dental graduates were well trained at taking and interpreting radiographs and diagnosing oral malignant and pre malignant conditions. This finding was similar to a study by Sina Haghani Far et al in 2015 ⁷ which concluded that 15 (23.8%) among the dental graduates of a dental college at Iran, assured that they can interpret radiolucent and radiopaque lesions in radiographs. When assessing the perceived competency in endodontic procedures among the study sample, most of the interns were confident in doing root canal treatment in single rooted teeth while a similar competency lacked in multirooted teeth. However 3.9% of the study population felt that they were not competent at endodontic and restorative

procedures. A study done by Abdulla Altorisy et al in 2023⁸ in Saudi Arabia noted a similar observation that 21.15% of the dental graduates were confident in identifying root canal orifice while performing root canal treatment and suggested that the dental graduates require more training and expertise in endodontic procedures

Majority of the dental graduates expressed that they needed more training in various types of extractions which includes simple to complex procedures. Among the procedures, most of the study population felt fabricating and activating orthodontic appliances needed additional guidance followed by repairing dentures, tooth preparation and restorative skills. The limitations of the present study was that the social desirability bias was unavoidable in the present questionnaire study and the study lacked temporality due to its cross sectional study design.

Further research is recommended to validate the current study observations by including students of other dental institutions. Dental teaching institutions can implement various workshops for improving clinical skill advancement and increase the practical sessions for the graduates for building skills to provide good training and treatment exposures in order to raise dentists with adequate

knowledge and practical skill which is unevitable today for dental graduates for their career advancement .

Conclusion

The current study conducted in a dental teaching institute at Kozhikode, observed that 65.8% of the dental graduates were confident to start dental practise just after graduation. While assessing the level of competency among the dental graduates proved that majority of the dental graduates were aware to take and interpret radiographs, diagnose oral lesions and malocclusion. 90.8% and 19.7% of the dental graduates were confident enough to do root canal treatment in anterior teeth and posterior teeth respectively. Among the 46.1% of the dental graduates claimed that more training and exposure is required during their dental curriculum at the institution to improve their practical skills in multiple practical procedures.

Therefore teaching institutions should identify the students who lack the necessary knowledge and skills as prescribed by the dental council of India and provide guidance and support for a better learning and practical exposure at their institutions. Teaching institutions can implement various workshops and increase practical patient exposure skills among the dental graduates.

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Periodontal disease awareness: A Review of public perception, severity, and the impact of education and health promotion

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Abstract

Periodontal disease is defined as a chronic inflammatory condition that affects the gums and their supporting structures, resulting in significant tooth loss and being associated with various systemic health issues, including cardiovascular diseases and diabetes. Despite its widespread occurrence, public awareness and understanding of this condition remain insufficient, leading to delayed diagnoses and suboptimal health outcomes. This review aims to evaluate the current state of public awareness and perceptions regarding periodontal disease, as well as the effectiveness of educational and health promotion strategies designed to address these challenges. Key discussion points include the contributions of dental professionals, public health campaigns, school-based initiatives, and community outreach efforts in enhancing public understanding. Additionally, the role of digital media and online resources in promoting oral health education is highlighted. The review identifies several barriers to awareness, including limited access to dental care, low health literacy, and socio-economic or cultural factors, and provides recommendations for overcoming these obstacles. Ultimately, this review advocates for targeted public health initiatives and further research to improve awareness and prevention strategies for periodontal disease, thereby enhancing public health outcomes.

Key words: Periodontal Disease, Public Health Campaigns, Barriers in Oral Health, Dental Professionals, School Based Programmes

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Introduction

Periodontal disease, often termed gum disease, comprises a variety of inflammatory conditions that impact the

supporting structures of the teeth, which include the gums, periodontal ligaments, and alveolar bone. This disease is primarily classified into two stages: gingivitis, which is characterized by an irreversible inflammation of the gums, and

periodontitis, a more advanced stage that can result in tissue damage, increased tooth mobility, and the potential loss of teeth. Periodontal disease is recognized as one of the most prevalent health issues among adults, with a concerning global prevalence estimated at nearly 50% among individuals over the age of 18 affected by some form of periodontal condition.¹

Untreated periodontal disease can have extensive implications that extend beyond the oral cavity, contributing to systemic health issues such as cardiovascular diseases, diabetes, and respiratory disorders.²

The chronic inflammation associated with periodontitis has been demonstrated to aggravate the existing burden of these systemic conditions, thereby underscoring the importance of early detection and intervention.³ The objective of this review is to evaluate the existing levels of public awareness concerning periodontal disease and to assess the severity of this condition. Furthermore, it will investigate the contributions of education and health promotion in improving oral health outcomes.

The review seeks to provide insights into the development of effective strategies for raising public awareness and promoting health, with the goal of encouraging preventive practices that can mitigate the global burden of periodontal disease,

drawing upon findings from existing literature.

Public Awareness and Perceptions of Periodontal Disease

Despite the widespread prevalence of periodontal disease, public awareness remains limited, which hinders effective prevention and early intervention efforts. Pihlstrom et al. (2005) identified that younger individuals and those from lower socioeconomic backgrounds are less likely to appreciate the significance of periodontal health, leading to a reduced frequency of dental visits and a higher prevalence of untreated conditions within these populations.⁵

By 2012, Dye et al. underscored that external factors, including lifestyle choices, personal hygiene, and family health history, are frequently neglected in the public discourse surrounding periodontal disease. These knowledge deficiencies contribute to delays in seeking care, allowing the disease to progress without detection.

A survey conducted in 2016 by the American Academy of Periodontology, as reported by Genco, indicated that a significant number of individuals are unaware of the associations between periodontitis and many systemic health conditions, including cardiovascular disease and diabetes.⁴

Zhang et al. (2020) observed that moderate stages of periodontal disease, which often present with no symptoms, are frequently overlooked until more severe complications, such as tooth loss, manifest.⁶ These findings underscore the necessity for targeted public health interventions aimed at addressing the knowledge gaps across various demographic groups, particularly those differentiated by age, education, and socioeconomic status.

Education and Health Promotion Strategies

Effective educational and health promotion initiatives are critical in enhancing public awareness of periodontal disease, preventing its onset, and facilitating early intervention. Various approaches, including direct consultations, public health campaigns, and community programs, serve as primary methods for disseminating oral health education to the public, thereby influencing knowledge and behavioral changes within the population.

Role of Dental Professionals

Dental professionals, including periodontists, general dentists, hygienists, and dental educators, play a pivotal role in managing individuals' oral health while simultaneously acting as primary advocates for prevention and awareness. This advocacy occurs during routine dental examinations, where dentists can provide

patients with essential information regarding the signs, risk factors, and severity of periodontal disease, as well as recommended interventions and management strategies.¹¹

Public Health Campaigns

Public health campaigns aimed at raising awareness about periodontal disease represent effective strategies for a broad-based approach to health education. Notable examples of successful campaigns include the American Dental Association's "Give Kids A Smile" program and the British Dental Association's "Brush Up On Your Oral Health" initiative, both of which have utilized mass media platforms such as television, radio, and print advertisements to disseminate essential information to the public.⁷ Such campaigns primarily focus on promoting preventive behaviors, including regular brushing, flossing, and dental checkups, with the aim of decreasing the prevalence of periodontal disease within targeted populations.

School-Based Programs

School-based oral health education programs serve as another effective mechanism for raising awareness and encouraging preventive behaviors among children and adolescents.⁹ These programs specifically target young individuals, imparting knowledge about the significance of maintaining good oral hygiene as a

lifelong practice that can mitigate the risk of developing periodontal diseases.

Community Outreach Initiatives

Community outreach programs are designed to address the needs of underserved populations and to enhance dental education accessibility for all individuals. These initiatives represent a collaborative effort among dental professionals, public health departments, and various non-governmental organizations, which provide complimentary dental examinations, treatments, and educational resources to communities with limited or no access to dental care.

Notable examples of such initiatives include mobile clinics and health fairs, where essential dental services are delivered, and residents receive information regarding periodontal health. Research indicates that community-based outreach programs have effectively raised awareness of periodontal disease and improved self-reported oral health behaviors, such as increased frequency of brushing and flossing.⁸

The Influence of Digital Media and Online Resources

In recent years, there has been a significant rise in the utilization of digital media and online resources for educating the public about periodontal diseases and promoting

overall health. Social media platforms and video content facilitate real-time access to a global audience. Online health resources provided by professional organizations, such as the American Academy of Periodontology, offer clear and comprehensible information on a range of topics, from fundamental oral hygiene practices to the systemic health risks associated with periodontal disease.¹⁰

Barriers to Awareness and Knowledge

Despite the increasing awareness and understanding of periodontal disease and its implications for overall health, several barriers continue to hinder public knowledge and access to information. A primary obstacle is the limited access to dental care, which affects individuals in various ways; some are unable to afford treatment, while others reside in remote areas. This lack of access contributes to the absence of regular screenings and early detection, ultimately resulting in a higher incidence of untreated periodontal disease.¹²

Another critical barrier is low health literacy, particularly concerning oral health. Many individuals do not possess the necessary knowledge or comprehension of fundamental health information, such as recognizing the signs and risk factors associated with periodontal disease.

Insufficient literacy can impede an individual's ability to appreciate the significance of preventive care, potentially leading to inadequate oral hygiene practices and delays in seeking treatment.¹³

Additionally, cultural and socioeconomic factors significantly influence awareness levels. In certain cultures, oral health may not be prioritized, or there may be misconceptions regarding the severity of periodontal disease. Individuals from lower socioeconomic backgrounds often lack the financial means to access dental care services and the educational resources necessary to understand oral health issues.¹²

Conclusion

There exists a significant need to enhance awareness and education regarding periodontal disease, a condition that is both prevalent and frequently underestimated. The principal findings indicate a significant lack of public understanding, attributed to practical barriers in accessing dental care, challenges related to health literacy, and various cultural or socioeconomic factors. This underscores the importance of integrating educational initiatives with dental professionals into a comprehensive strategy for health promotion, which should encompass public health campaigns, school-based programs, and community

outreach efforts aimed at informing the public and fostering preventive behaviors.

Future research should focus on evaluating the effectiveness of utilizing digital media in health promotion strategies specifically designed for underserved populations.

Recommendations

- **Dental Professionals:** It is imperative to consistently educate patients about the connection between periodontal disease and systemic health, as well as to communicate prevention and treatment strategies during routine dental appointments.
- **Public Health Organizations:** There is a need to implement culturally sensitive awareness campaigns aimed at early detection and prevention, particularly targeting underserved populations.
- **Policy Makers:** It is essential to establish appropriate measures to improve access to dental healthcare for low-income and rural communities by promoting oral health education programs within schools and local communities.

These initiatives should be accompanied by critical recommendations aimed at reducing the global burden of periodontal disease and enhancing both oral and overall health outcomes.

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Case Report

The Flare-up challenge: Endodontic management in Trauma Cases

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Abstract

Endodontic treatment following dental trauma can sometimes lead to pain and swelling, known as endodontic flare-ups. These flare-ups, occurring in 1.4% to 50% of cases, can be distressing for both dentists and patients. Multiple factors contribute to their development, including microbial activity, patient-related factors, and treatment-related factors. Microbial activity is a significant contributor, often triggering acute periradicular inflammation due to irritants migrating from the root canal system. Various preventive and management strategies exist to minimize flare-ups after endodontic treatment in traumatized teeth. Understanding the underlying causes and effective interventions is crucial for reducing these complications.

Key words: Dental Traumatic Injuries, Endodontic Treatment, Flare-Up, Root canal Infection

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Introduction

Dental traumatic injuries (TDIs) encompass a range of physical injuries to the teeth, gums, and surrounding oral structures.

They are quite common in dentistry, comprising 5% of all traumatic injuries in people seeking first aid and up to 17% of all bodily injuries among preschool children.¹

Petti et al found that traumatic dental injuries occur in both primary and permanent dentitions, although the prevalence in primary dentition is higher. Prevalence differs with age and sex, with a global male-to-female ratio of 1.43, suggesting that men are more likely to develop TDI than are women.²

Most TDIs can be broken down into smaller components and related to the affected tissues, namely dental hard tissues, dentine-pulp complex, periodontium, alveolar bone or gingiva. As one of the five oral tissues which can be affected by TDIs, the pulp plays a key role and its management has a substantial impact on the long-term survival of the tooth, particularly in severe cases.³

Specifically, untreated injuries can create an environment conducive to bacterial growth, leading to infections and abscesses that may spread to surrounding tissues and bones. This progression can necessitate more extensive treatments in the future and can severely compromise overall oral health. Additionally, untreated TDIs can result in malocclusion (misalignment of teeth), aesthetic concerns, and psychological distress due to the visible impact of dental injuries. For instance, children with untreated dental trauma often experience

negative effects on their quality of life, including social and emotional challenges compared to those whose injuries are treated. Therefore, prompt intervention is essential to mitigate these risks and preserve both oral health and overall quality of life.

This article presents a case report of a 12-year-old female patient experiencing long-term complications due to untreated dental trauma. Additionally, it highlights how untreated trauma can compromise oral health, necessitating more invasive and costly interventions.

Case Report

A 12 year-old female patient presented to the Dept of Pediatric and Preventive Dentistry with a complaint of pain in the upper left front tooth. (fig 1) On history taking, it was revealed that she had fallen from the stairs three years ago, resulting in the fracture of her tooth, for which no treatment was sought. Clinical examination showed a fractured maxillary left central incisor (tooth #21) with pulpal involvement, indicative of an Ellis Class III fracture, along with discoloration and no response to thermal stimuli. (fig 2) Radiographic examination via an intraoral periapical (IOPA) radiograph confirmed a fracture involving enamel, dentin, and pulp, with periapical

radiolucency suggestive of pulpal necrosis and open apex but no signs of root resorption or alveolar bone loss.(fig3) The treatment plan included apexification followed by endodontic therapy to preserve the tooth.



Figure 1 : Showing fractured left central incisor irt 21



Figure 2: A complicated crown root fracture irt 21



Figure 3 :Radiograph showing open apex with periapical lesion irt 21

Treatment Approach:

- Access opening of 21 was performed under local anesthesia, and the necrotic pulp tissue was removed. However, the patient experienced severe pain and swelling within 24 hours, indicative of an endodontic flare-up.(fig4) Emergency intervention included thorough canal irrigation with chlorhexidine and saline, administration of intracanal medicament , and prescription of analgesics and antibiotics.



Figure 4: Extraoral swelling noted within 24 hrs.

- However, the symptoms did not subside, necessitating the administration of intravenous (IV) antibiotics for effective infection control. Following IV antibiotics the symptoms gradually subsided, a repeat biomechanical preparation (RBMP) was performed; however, the patient still experienced pain. To manage this, calcium hydroxide

medicament was placed in the canals until the lesion subsided. The dressing was changed at three-week intervals to ensure optimal healing. Once the lesion had resolved, endodontic treatment was completed with the placement of mineral trioxide aggregate (MTA) at the apex, followed by core buildup.(fig 5)

Outcome and Follow-Up:

Following IV antibiotic therapy and calcium hydroxide dressing changes, the symptoms gradually subsided, and the root canal treatment was successfully completed. The patient was followed up for six months, showing complete healing with no further complications.(fig 6)



Figure 5: Radiograph showing completely healed periapical lesion in RC treated 21





Figure 6 : Post endo restoration

Discussion

- Traumatic dental injuries are caused by physical impact that generates sufficient mechanical energy to produce the tissue injury. In children, the main causes of dental trauma are falls and injuries sustained during play, often involving single tooth injuries. In adolescents and adults, sports accidents, fights and motor vehicle accidents may result in more complex trauma involving several teeth simultaneously. Although the traumatic scenarios may be different, the mechanical and biological factors involved in the mechanisms of trauma determine the type and severity of resulting injury sustained by the tissue.

Tissue responses can be favourable or unfavourable in nature. Favourable responses require little to no intervention, aside from periodic reviews to monitor the

pulp, periradicular, and soft tissue health over time, ensuring no adverse changes develop that would necessitate treatment. The most serious and complicated consequences of these injuries are pulp necrosis and infection of the root canal system, external inflammatory root resorption, external replacement root resorption, ankylosis, bone resorption, loss of attachment and gingival recession followed by subsequent tooth loss. It is essential for clinicians to know what is being treated, whether it should be treated, why and when, and how it should be treated.⁵

The probable causes of endodontic flare up in this case are

i) Chronic pulp inflammation

It can develop when dentinal tubules are deeply exposed due to crown fractures, and when complicated crown fractures with exposed pulp remain untreated for an extended period. In such cases, granulation tissue proliferates extensively at the affected site. If bacteria and other harmful irritants from the oral environment cause only mild irritation, the inflammation may begin locally and gradually spread throughout the pulp.



Figure 7: Schematic representation of the progression of pulp and root canal conditions through the various stages of the disease process; root canal system (RCS), root canal treatment (RCT) ⁶

ii)Pulp Necrobiosis

When plaque and debris are permitted to accumulate into the exposed pulp, bacteria will colonize into the wound, causing a localized pulp abscess with intense inflammation in the adjacent pulp tissue. Pulp necrobiosis implies the concurrent presence of both inflamed and necrotic, infected pulp tissue. The necrotic infected tissue is usually in the coronal portion of the pulp with the inflamed tissue apically. Peri radicular damage during RCT can lead to flare-ups. As this happens, there is development of an immune response by the body leading to pain and swelling.(fig 7)

iii)Microbial cause of endodontic flare up

Inter-appointment flare-up is characterized by the development of pain, swelling or both, following endodontic intervention.

The causative factors of flare-ups encompass mechanical, chemical and/or microbial injury to the pulp or peri radicular tissues. Of these factors, microorganisms are arguably the major causative agents of flare-ups. ⁷

In asymptomatic chronic peri radicular lesions associated with infected teeth, there is a balance between microbial aggression (from the infecting endodontic microbiota) and host defense in the peri radicular tissues(fig 8). During chemo-mechanical preparation, if the microorganisms are apically extruded, the host will face a situation in which it will be challenged by a larger number of irritants than it was before. Consequently, there will be a transient disruption in the balance between aggression and defence in such a way that the host will mobilize an acute inflammation to re-establish the equilibrium.⁸

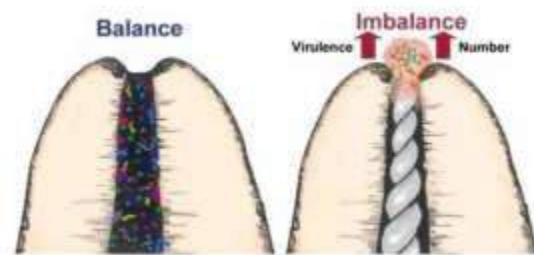


Figure 8 : Apical extrusion of microorganisms and/or their products during chemo-mechanical procedures.

Reddy and Hicks showed that cleaning canals with manual instruments using step-back technique leads to a higher amount of extrusion of debris (2.58 mg) into the periradicular tissues than NiTi rotational mechanical instruments (0.5 mg) with crown-down technique.¹⁶

iv) Microbial Synergism Or Additism

Most of the endodontic pathogens show virulence when they are in association with other species.^{11,12} This is because of synergistic or additive microbial interactions, which can certainly influence virulence and play a role in symptom causation.⁹

v) Increase in the oxidation–reduction potential

Another form of environmental change induced by endodontic intervention refers to the entrance of oxygen in the root canal. It has been suggested that this can alter the oxidation–reduction potential (Eh) in the root canal and, as a consequence, acute exacerbation can occur.¹⁰

vi) Host resistance

Different individuals present different patterns of resistance to infections and such differences can certainly become evident during an individual's lifetime.¹²

Individuals who have reduced ability to cope with infections are more prone to develop clinical symptoms after endodontic procedures in infected root canals.¹¹

vii) Presence of pre-operative pain

There is strong correlation between pre-operative pain and flare-ups. If microorganisms from infected root canal are forced into the periapical tissues, it can lead to the occurrence of flare-ups.¹²

viii) Secondary Intraradicular Infections

Secondary intraradicular infections are caused by microorganisms that were not present in the primary infection and have gained entry into the root canal system during treatment, between appointments, or even after the conclusion of the endodontic treatment, the most common being a breach of the aseptic chain during treatment. If the microorganisms that gain access to the root canal are successful in surviving into and colonizing such a new environment, a secondary infection will establish itself.¹³

ix) Incomplete instrumentation

Incomplete chemomechanical preparation can disrupt the balance within the microbial community by eliminating some inhibitory species and leaving behind other previously inhibited species, which can then overgrow. If

overgrown strains are virulent and/or reach sufficient numbers, damage to the periradicular tissues can be intensified and then result in lesion exacerbation.

x)Non-Microbial Causes

Non-microbial causes are represented by chemical or physical factors that can inflict damage to the periradicular tissues, and thereby can be responsible for the development of interappointment pain.

a)Mechanical irritation causing periradicular inflammation includes mainly over instrumentation and overextended filling materials.

b)Chemical irritation includes apical extrusion of irrigants or intracanal medications. Most irrigants and medications are cytotoxic to the host tissues.¹²

Formocresol may act as a hapten, which binds to host proteins and stimulates an immunological response. Moreover formaldehyde is considered cytotoxic, causing necrosis of living tissue and if extruded in the periradicular area will lead to pain and swelling.¹⁷

c)Inflammatory events leading to interappointment flareup

Interappointment pain is exclusively due to

the development of acute inflammation at the periradicular tissues. Following injury to the periradicular tissues, a myriad of chemical substances are released or activated, which will mediate characteristic events of inflammation, such as vasodilatation, increase in vascular permeability, and chemotaxis of inflammatory cells. The chemical mediators of inflammation include vasoactive amines, prostaglandins, leukotrienes, cytokines, neuropeptides, lysosomal enzymes, nitric oxide, oxygen-derived free radicals, and plasma-derived factors (complement, kinin, and clotting systems).¹³

d)Patient-Related Factors

Various studies have shown that female gender, necrotic pulp, acute apical abscess, acute apical periodontitis, large periapical radiolucency and pre-operative pain and swelling have an increased risk of developing an endodontic flare-up.¹⁴

The management of this endodontic flare-up was carried out systematically, ensuring both infection control and periapical healing. Initially, the patient was reassured about the temporary nature of the reaction. To relieve pressure, the canal was reopened, allowing drainage, followed by copious irrigation with saline and chlorhexidine to reduce the

bacterial load. Intracanal calcium hydroxide was placed as a medicament, with dressing changes every two weeks to maintain an antimicrobial environment and promote periapical healing. This step effectively helped in reducing inflammation and stimulating osteoblastic activity. The action of $\text{Ca}(\text{OH})_2$ is directly influenced by its high pH. The alkaline pH not only neutralizes lactic acid from osteoclasts, but could also activate alkaline phosphatases, which play an important role in hard-tissue formation.¹⁻⁵ Anjaneyulu et al demonstrated that usage of chlorhexidine with or without $\text{Ca}(\text{OH})_2$ reduces postoperative pain.¹⁶ Once the lesion had healed almost completely, mineral trioxide aggregate (MTA) was placed at the root apex to establish a biocompatible apical seal and encourage further mineralization. Finally, the canal was obturated, ensuring a well-sealed and stable outcome. This stepwise approach facilitated effective infection control, guided periapical healing, and contributed to the long-term success of the treatment.

Prevention

Due to the fact that flare-up is a multi-etiological process, a prevention strategy should be taken into consideration.

However, till date, no prevention strategy is scientifically approved and adopted by the endodontic community. Yet, some instructions are recommended during treatment, which could help to decrease the incidence of flare-up. This include:

i)Asepsis: Maintain strict aseptic conditions using rubber dams to prevent contamination.⁸

ii)Minimizing Debris Extrusion: Use techniques like crown-down with Ni-Ti systems and proper irrigation. Apex locators and radiology aid in precise working length determination.⁷

iii)Preoperative Medication: Ibuprofen, dexamethasone, diclofenac sodium, piroxicam, and other anti-inflammatory drugs can help in cases of symptomatic irreversible pulpitis.¹⁸

iv) Single-Visit Treatment: When feasible, complete treatment in one visit. For infected teeth, use intracanal medication between sessions. Postoperative pain management includes corticosteroids, NSAIDs, or paracetamol.¹⁹

Conclusion

Flare-ups due to trauma are complex reactions influenced by inflammatory, microbial, and immune responses. While proper endodontic management can reduce

their occurrence, complete prevention remains challenging. Early intervention, aseptic techniques, and appropriate medication play crucial roles in minimizing complications. Further research is needed to develop standardized protocols for managing traumatic flare-ups effectively.

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Review Article

Exploring the interconnection between Periodontics and Orthodontics : A Review

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Abstract

The critical collaboration between orthodontics and periodontics within the field of dentistry highlights the necessity for effective diagnosis and treatment planning that involves cooperation and coordination among various dental specialties.

The interplay between orthodontics and periodontics is characterized as symbiotic, indicating that both disciplines can derive mutual benefits. For instance, the movement of teeth through orthodontic intervention can enhance periodontal health by achieving proper alignment, which facilitates improved plaque control and reduces the risk of periodontal disease. Conversely, periodontal therapy can create a healthier environment conducive to more effective orthodontic treatment by addressing any underlying gingival issues that may hinder tooth movement.

This interrelationship emphasizes the importance of an integrated approach to dental care, where specialists collaborate to ensure optimal patient outcomes.

Keywords: *Orthodontics, Periodontics, Plaque control, Malocclusion*

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Introduction

Orthodontic treatment exerts a considerable impact on periodontal tissues. The condition of periodontal health is inextricably linked to the outcomes of orthodontic procedures. Patients undergoing orthodontic treatment

frequently encounter difficulties in preserving oral hygiene because of the brackets and wires present, resulting in a higher accumulation of plaque. Poor periodontal health has the potential to hinder the effectiveness of orthodontic treatment.

Orthodontic care has a dual effect on periodontal health. Smoothly enhancing periodontal health through proper teeth alignment, thus enabling better plaque control and lower risk of periodontal disease. If not managed carefully, orthodontic treatment can lead to complications. These may include gingival recession, bone dehiscences, gingival invaginations, and the formation of gingival pockets.

Periodontal therapy emphasizes maintaining the health of the supporting structures surrounding the teeth, while orthodontic treatment strives to achieve correct tooth alignment for both functionality and aesthetics.

Effects of orthodontics in the periodontal diseases

Misaligned teeth, commonly referred to as malocclusion, can increase the possibility of developing gingival diseases like gingivitis and periodontitis can significantly impact oral health. Orthodontic treatment helps in the alignment of teeth, enhancing occlusion which can reduce the chances of periodontal disease. While braces are advantageous for dental alignment, they may also complicate brushing and flossing, thereby elevating the risk of periodontal issues and other oral health problems.^{1,2} Hence, orthodontic treatment should be accompanied by

suitable oral hygiene practices to ensure optimal outcomes.

Orthodontic appliances and plaque accumulation

Orthodontic appliances can contribute to the accumulation of plaque. The brackets and wires present in traditional braces create multiple small spaces, which complicates the process of effective oral hygiene. The accumulation of plaque on teeth can lead to tooth decay and gum disease.³

Patients with orthodontic appliances should be diligent in their oral hygiene routines. It is important to brush and floss regularly, as well as use a mouth rinse, to effectively remove oral debris. Regular dental check-ups and cleanings can aid in the prevention of plaque accumulation and promoting overall oral health.

Orthodontic appliances and gingival inflammation

Orthodontic appliances, including traditional braces and clear aligners, can contribute to gingival inflammation in patients. The pressure and friction exerted by dental appliances on the gingival tissues may also cause infection and erythema. Furthermore, poor oral hygiene can cause plaque buildup across the brackets and

wires increases the risk of developing gingivitis.⁴

Therefore, it is essential for patients to maintain proper oral hygiene and attend regular dental appointments.

Orthodontic treatment in patients with periodontal diseases

Orthodontic treatment in patients with periodontal disease requires careful attention and a multi-disciplinary approach to achieve both functional and aesthetic outcomes. Periodontal diseases can adversely affect the success of orthodontic procedures⁵. One key benefit of orthodontic treatment is that it helps address crowded teeth, which are harder to clean and may contribute to further damage to the periodontal tissues.

Before beginning orthodontic treatment, it is crucial to manage any pre-existing periodontal conditions through therapy to control inflammation and stabilize the periodontal attachment.

In addition, orthodontic treatment has the potential to enhance periodontal health through proper alignment of teeth, making them easier to clean and reducing the risk of future periodontal issues.

Benefits of orthodontic treatment in periodontal patients

Orthodontic treatment can effectively produce positive outcomes for adult patients dealing with periodontal diseases. The consideration of the following factors is essential:

1. Alignment of crowded or malaligned anterior teeth enables adult patients to effectively clean all tooth surfaces in a more efficient manner.
2. Tipping or the physical movement of teeth through orthodontic treatment leads to the enhancement of specific types of bone defects in periodontal patients.
3. Aligning the gingival margins orthodontically can eliminate the need for gingival recontouring.
4. The open gingival embrasure in the maxillary anterior region is perceived as highly unaesthetic by the patient. Orthodontic treatment can help restore lost papilla.
5. Orthodontic treatment aids in straightening the neighboring tooth prior to implant placement or tooth replacement.

There is a correlation between malocclusion and periodontal health in which malocclusion may serve as an indicator for periodontal diseases.⁶

In a study, reported that there is a potential loss of attachment during orthodontic treatment.⁷

All evidence-based literature on the orthodontic-periodontic relationships demonstrates that a orthodontic treatment provided to patients with good oral hygiene, and no periodontal breakdown, offers benefits to the periodontium. When oral hygiene is not adequately maintained and periodontal support is weak, orthodontic treatment in these patients can pose a threat to the periodontium.^{8,9}

In contemporary dental practices, genetic predisposition, age, comprehensive diagnosis, and effective treatment execution are crucial factors. Good oral hygiene also plays a vital role in the success of orthodontic treatments.¹⁰

Benefits of periodontics in the orthodontic therapy

In many instances, achieving a stable and aesthetically acceptable result with orthodontic treatment requires the support of periodontal procedures. For example, a high labial frenum attachment can lead to a midline diastema, and in such cases, a frenectomy is recommended to correct the issue.¹¹

Forced eruption of an impacted tooth, whether labial or palatal, is a frequently

used orthodontic technique. Careful attention must be paid to expose the impacted tooth while preserving the surrounding keratinized tissue. This is crucial to prevent attachment loss, and the most effective surgical technique for preserving this tissue is an apically or laterally positioned pedicle graft.¹²

Retention of teeth after orthodontic treatment is essential, but it can present a challenge for orthodontists. One effective method to enhance retention is circumferential supracrestal fiberotomy (CSF), which helps in maintaining tooth position. Mucogingival surgeries may be required during orthodontic treatment to maintain an adequate width of attached gingiva.¹³

In cases where the clinical crowns are short, crown lengthening procedures can facilitate bracket placement and may also contribute to aesthetic improvements in smile design.¹⁴ The alveolar ridge augmentation procedure and dental implants, also support the achievement of orthodontic goals.

A more recent surgical orthodontic therapy was introduced by Wilcko et al. which included the innovative strategy of combining corticotomy surgery with alveolar grafting in a technique referred to as Accelerated Osteogenic Orthodontics (AOO) and more recently to as PAOO.^{15,16}

Conclusion

Therefore the interdependence between orthodontics and periodontics in dentistry is evident. Orthodontists need to collaborate closely with periodontists to create treatment plans that help the requirements of the patient.

The key to a successful ortho-perio interrelationship lies in meticulous attention to detail, seamless communication, and unwavering dedication to delivering top-tier care. By staying vigilant, dental professionals can assist their patients in attaining the best possible oral health results.

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“The Hall Technique in Pediatric Dentistry: A Paradigm Shift in Caries Management A Comprehensive Review”

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Abstract

Introduction: The high frequency of caries in primary teeth and its inadequate treatment are major public health problems during childhood. Nowadays, the Hall technique is one of the methods used for biological sealing in carious lesions in primary molars. Thus, the bacteria will be sealed from oral environment and the caries will be inactive. The Hall Technique (HT) is a minimally invasive method for managing carious lesions in primary molars. It involves placing and cementing stainless steel crowns without removing caries, preparing the tooth, or using local anesthesia, making it a more child-friendly alternative to traditional restorative treatments.

Methodology: A thorough literature review was conducted on PubMed using relevant keywords such as Hall Technique, early childhood caries, minimal intervention, pediatric dentistry, oral hygiene, dental pulp, and stainless steel crowns.

Results: HT is widely accepted by children and parents due to its reduced discomfort. However, limitations include esthetic concerns and the potential for plaque accumulation if crown adaptation is inadequate. Successful outcomes rely on proper case selection and assessment of pulp health.

Conclusion: HT provides a safe and effective treatment for carious primary molars and hypomineralized teeth. It minimizes pain, psychological distress, and dental trauma while being a time-efficient and cost-effective alternative to conventional techniques.

Keywords: Hall Technique, early childhood caries, minimal intervention, Pediatric dentistry, stainless steel crowns

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Introduction

The management of carious lesions in primary teeth has evolved toward minimally invasive techniques that prioritize patient comfort and long-term dental health. Recent advancements in cariology have led to a paradigm shift favoring conservative treatments, acknowledging dental caries as a consequence of an imbalance between tooth demineralization and remineralization, driven by plaque biofilm metabolism and dietary sugars.¹ Hall's technique (HT) has been established as a novel method for managing decayed primary molars. A general practitioner, Dr. Norna Hall, had been treating carious primary molars with the preformed metal crown in an unconventional way, not using local anesthesia, removing caries or preparing the tooth.² The prime success of HT depends on sealing caries with a preformed metal crown. By inhibiting microorganisms from their source of dietary carbohydrate and nutrition can prevent the advancement of caries^(3,4). While traditional approaches for deep carious lesions aim at pulpal interventions to maintain tooth functionality, Minimal Intervention

Dentistry seeks to preserve vitality, function, and asymptomatic state until exfoliation.⁵

HT is particularly beneficial for young and anxious children as it eliminates the need for invasive procedures, reducing pain, anxiety, and negative dental experiences. Numerous studies have reported high success rates, with improved patient and caregiver acceptance compared to conventional restorative treatments. However, proper case selection is crucial, as inappropriate application may lead to issues such as plaque accumulation or esthetic concerns.

This paper explores the clinical effectiveness, advantages, and limitations of the Hall Technique based on a comprehensive review of existing literature, highlighting its role as a conservative and child-friendly alternative in managing primary molar caries.

2. Methodology

A comprehensive PubMed search was conducted, and the findings were presented along with critical commentary where applicable. This review highlights general

information about the Hall Technique and its application in pediatric dentistry

3. Results

3.1 Description

Modern dentistry is increasingly embracing biological and minimally invasive treatments for both primary and permanent teeth, moving away from traditional restorative methods that require complete caries removal. In 1997, Dr. Norna Hall introduced a novel approach for managing decayed primary molars using preformed metal crowns, now known as the Hall Technique (HT). HT doesn't involve local anesthesia, cavity removal, or tooth preparation. When applied, it seals the superficial plaque layer with the carious lesion, isolating it from external nutrients in the oral cavity. This alters the plaque biofilm composition, creating a less cariogenic environment and potentially halting or slowing caries progression in primary teeth.⁶

Minimally invasive treatments, such as HT, offer the advantage of preserving tooth structure and maintaining maximum dentin thickness on the cavity floor, minimizing damage to pulp tissue⁽⁷⁾. Successful treatment planning relies on accurate detection, assessment, and diagnosis of carious lesions, integrating

this information with a comprehensive history and understanding of treatment indications and contraindications.⁸ In the application of HT, considerations include the use of orthodontic separators for non-spaced teeth, determining crown size through measurement or trial and error, and caution during the cementation process to avoid protruding margins. Alterations in bite and occlusion may occur temporarily but usually normalize within days to weeks. The molar, "sealed" beneath the crown during the two-session procedure, effectively arrests the caries process. HT, well tolerated by children, provides long-lasting restorations with high survival rates.^{9,10} Additionally, the HT procedure is complemented by personalized preventive guidance. Some researchers have reported modifications to the technique, including partial caries removal or trimming of proximal teeth. Mastery of the technique is essential for proper implementation, highlighting the importance of providing detailed step-by-step explanations to parents or caregivers and addressing any concerns regarding the treatment.



3.2 Advantages

The Hall Technique (HT) presents dentists with a swift and definitive treatment, effectively minimizing patient anxiety.¹¹ By eliminating the need for local anesthesia, HT aims to enhance child compliance and operator comfort. Beyond cavity sealing, it anticipates providing a less traumatic dental experience early in a child's life, fostering a likelihood of their return for more complex treatments in the future.¹² HT combines the biological management of carious lesions, achieved by sealing bacteria and depriving them of nutrition, with the restorative benefits of preformed metal crowns.¹³ Comparisons between the Hall Technique (HT) and conventional methods indicate similar performance in terms of marginal leakage, suggesting that complete caries removal is not essential for achieving an effective seal. Utilizing preformed metal crowns with HT for managing dentinal caries in primary teeth lowers the risk of pain and restoration failure. The technique has been shown to reduce discomfort, making it a preferred choice among both patients and parents. Additionally, HT offers shorter treatment times, greater cost-effectiveness, and higher parental acceptance compared to traditional restorative approaches. Children treated with the Hall Technique predominantly reported favorable

outcomes immediately post-treatment, with nearly 90% expressing satisfaction. A retrospective study in the United States demonstrated similar success rates in clinical and radiological outcomes for stainless steel crowns used in restoring primary molars with carious lesions, comparing the conventional technique and HT.¹⁴ HT is well-tolerated, cost-effective, and widely accepted by parents. It outperforms ART in survival rates and reduces dental anxiety while preserving tooth structure and simplifying treatment.

3.3 Disadvantages

The Hall Technique (HT) has some drawbacks, primarily its unesthetic appearance and the risk of plaque buildup if the crown is not well-adapted. Both major failures (irreversible pulpitis, dental abscess, periradicular radiolucency, and loss of crown with non-restorable tooth) and minor failures (loss of crown and restorable tooth, crown perforation, secondary/marginal caries, and reversible pulpitis) have been documented.¹⁵ Additionally, cases of the ectopic first permanent molar adjacent to the crowned tooth have been reported⁽¹⁶⁾ and in rare instances, internal root resorption can occur.¹⁷ Stress distribution in tooth-supporting tissues is noted to be greater with HT within the initial 2 weeks

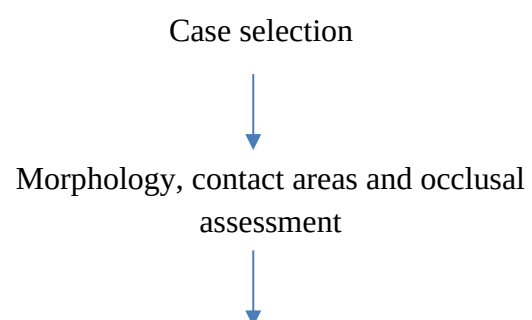
compared to the conventional crown placement technique, where settling occurs within 2 days.¹⁸ Additionally, HT is challenging for uncooperative patients, often requiring more invasive techniques and dental sedation.

3.4 Guidelines

The Hall Technique (HT) necessitates meticulous case selection and evaluation of pulp status. Determining pulp status involves a comprehensive approach, including medical history, clinical examination, mechanical tests (probing, blowing air), test cavities, percussion, and radiography. In situations where children cannot cooperate or obtain diagnostic images, the extent of decay and pulp vitality (vital or non-vital) becomes crucial for deciding on a treatment modality.¹⁹ Accurate diagnosis, treatment planning, and follow-up are crucial for success. HT is not a "fit and forget" approach; teeth must be symptom-free of pulpal pathology, such as irreversible pulpitis, before placement. If a crown is mistakenly placed due to diagnostic error or leads to pulp involvement, early detection during follow-ups is vital. HT is recommended for non-cavitated occlusal caries when fissure sealants, partial caries removal, or conventional restorations are not an option. It is also suitable for cavitated or non-cavitated proximal caries if the patient declines other treatments. Ideal candidates include

asymptomatic primary molars with multisurface or occlusal caries, hypoplastic molars, and both active and inactive carious lesions. Additionally, HT can be used for children and adults with intellectual or physical disabilities. Specific criteria for HT include caries limited to occlusoproximal surfaces extending to dentin, accessible to hand instruments used in Atraumatic Restorative Treatment (ART), absence of pain, fistula, or abscess near the selected tooth, no pulpal exposure, and cavity size less than 2.0 mm mesiodistally and 2.5 mm in the occlusocervical and buccolingual directions, measured with a WHO-classified periodontal probe.²⁰ Managing teeth affected by Molar Incisor Hypomineralization (MIH) is challenging, but HT offers a non-invasive solution by sealing carious lesions without decay removal or tooth preparation. Accurate diagnosis is essential for effective treatment planning, particularly regarding pulp status. Educating parents/caregivers on the importance of post-treatment follow-up is vital, ensuring early detection of any complications.

Step-by-Step Guide to the Hall Technique



If no space is present, separators are placed at contact points for **3–5 days**.



The selection of the desired crown size is done by measuring the mesiodistal diameter, vertical height, and crown fit determined using trial and error method



The crown is filled with glass ionomer luting cement and cemented



3.5 Contraindications

In a study, 34% believed there were no medical contraindications to Hall Technique (HT) use. Among those recognizing contraindications, immunocompromised and cardiac diseases were commonly cited, with additional mentions of leukemia, brain tumors, and other serious special needs conditions⁽²¹⁾ HT is contraindicated in cases of irreversible pulpitis, dental abscesses,

fistulas, radiographic signs of pulp involvement, or periradicular pathology. It is unsuitable for uncooperative patients due to the risk of crown aspiration or swallowing. Other contraindications include a high risk of infective endocarditis, immunocompromised children, severely damaged crowns with non-restorable cavities, very young children who cannot tolerate the procedure without anesthesia, nickel allergy, teeth nearing exfoliation, significant root resorption (over half the root), pulp exposure during treatment, excessive mobility, pulp necrosis, or dental abscesses. Hall crowns require careful follow-up after placement, with prompt treatment of pulp pathology if it develops. HT is not a universal solution for providing oral health care to disadvantaged or underserved populations⁽²²⁾ A thorough review of the patient's medical history is essential to identify any contraindications. Assessing pulpal status in young children can be difficult, making post-treatment follow-up crucial. Clear communication with parents/caregivers is necessary to set realistic expectations and ensure proper monitoring.



4. Conclusion

The Hall Technique is a major advancement in pediatric dentistry, providing a non-invasive alternative for managing carious primary molars. By sealing caries within stainless steel crowns without anesthesia or drilling, it reduces stress for young patients and promotes a positive dental experience. Clinically effective, it preserves masticatory function and offers cost advantages, especially in under-resourced settings.

Success depends on proper patient selection, precise execution, and regular follow-up. Comprehensive clinical and radiographic assessments are essential, along with clear communication with caregivers. While the technique faces challenges, such as marginal seal integrity and cultural perceptions of caries removal, ongoing education and research will support its broader acceptance and refinement for diverse clinical applications.

As pediatric dentistry evolves, the Hall Technique exemplifies the shift towards patient-centered, evidence-based care, reshaping treatment standards and expectations. It serves as a valuable tool for pediatric dentists, aligning with the principles of minimally invasive dentistry while promoting children's psychological

well-being and fostering lifelong positive dental experiences.

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Case Report

Restoring harmony: Hawley- type- Bimaxillary plate with Class III elastics in treating mild class III malocclusion - A Case Report

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Abstract

Introduction: Early intervention for anterior crossbite is advocated as it has detrimental effects on maxillofacial growth and function, including the potential development of temporomandibular joint disorder. **Objective:** The aim of this case report is to describe a treatment method for a growing patient with Class III malocclusion and maxillary retrusion using Hawley- type- bimaxillary plate with class III intermaxillary elastics [Ronsiville et al., 2023] attached at the hooks of the upper molar clasps and lower vestibular arch. **Case report:** A 9-year-old girl with mild class III malocclusion was treated using Hawley-type bi-maxillary plates (BMPs) and Class III elastics attached at the hooks of the upper molar clasps and lower vestibular arch. **Results:** After three months of active appliance therapy, there was a significant improvement in her overjet with value approaching the normal range after 3 months of active treatment. A 1mm overjet was attained. Soft tissue and skeletal relationship were also improved. There was increase in the SNA and ANB angles. There was reduction in the inter-incisal angle. **Conclusion:** BMPs may represent the best choice for those subjects affected by mild form of class III malocclusion, considering the patients' discomfort and treatment acceptance with bulky extraoral appliances

Key words ; Class III malocclusion; Interceptive orthodontics, Bi-maxillary plate with intermaxillary elastics

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Introduction

Class III malocclusions may occur due to prognathism of the mandible, retrognathism of the maxilla, protrusive mandibular dentition, retrusive maxillary dentition, or combinations of these (Ellis and McNamara, 1984; Guyer et al., 1986).¹ Skeletal Class III malocclusion is one of the most challenging malocclusions to treat. In around 40% of Class III patients, maxillary retrognathia is the main cause of the problem and in most patients, orthopaedic/surgical treatments include some type of maxillary protraction.² Early intervention for Class III malocclusion is advocated to reduce or re-direct mandibular growth and protract the maxilla, and restore the anterior guidance, maintaining the mandible constrained by the upper arch during growth [Schneider-Moser et al., 2005; Quinzi et al., 2023, D'Apuzzo et al., 2019]. Chin-cup is the treatment option in case of mandibular protrusion [Woon and Thiruvengkatachari, 2017], instead, Facemasks (FMs) are used when it is necessary to improve other conditions contributing to the development of the malocclusion such as maxillary retrusion combined with mandibular protrusion and lower facial height [McNamara et al., 1990; Aileni and Rachala, 2011; Piancino et al., 2019].³ Intra-oral appliances were also found to be effective in correcting Class III

malocclusion in mixed dentition, including functional appliances (Frankel III, Bionator III and Reverse Twin-block) [Yang et al., 2014; Seehra et al., 2012] or Class III horseshoe appliance [Yang, 1997; Lim et al., 2021]. Using extra-oral or intra-oral devices has its advantages and disadvantages, and the appropriate treatment modality should be selected based on accurate diagnosis and the severity of the malocclusion [Lo Giudice et al., 2022; Lo Giudice et al., 2023]. However, children presenting early or mild class III malocclusion (including pseudo-class III) could benefit from simple and less invasive intra-oral devices that can correct the sagittal inter-maxillary discrepancy with less discomfort compared to extra-oral appliances [Schneider-Moser et al., 2005]. A new variant of intra-oral appliance has been proposed to manage class III malocclusion in children [Ronsivalle et al., 2023], which consists of Hawley-type bi-maxillary plates (BMPs) and Class III elastics attached at the hooks of the upper molar clamps and lower vestibular arch. Figure 1 . BMPs connect all the dentition regardless of the presence of spaces while the retention is obtained by the presence of clamps underneath dental undercuts and by the elasticity of the acrylic resin.³



Figure 1: Hawley-type bi-maxillary plates (BMPs) and Class III elastics attached at the hooks of the upper molar clamps and lower vestibular arch

The aim of this case report is to describe a treatment method for a growing patient with Class III malocclusion and maxillary retrusion using Hawley- type- bimaxillary plate with class III intermaxillary elastics [Ronsivalle et al., 2023] attached at the hooks of the upper molar clasps and lower vestibular arch.

Case report

A 9-year-old girl with reverse overjet and maxillary retrognathia was referred for orthodontic therapy. Patient had no significant medical history that could interfere with orthodontic treatment. The girl was in mixed dentition period. Clinical examination depicted a mild Class III malocclusion with a straight profile, retrognathic maxilla and upper lip . Figure 2



Figure 2: Front profile and straight profile

The patient had an anterior crossbite with - 2mm overjet and Molars had a Class I dental relationship .

Upon guiding the patient towards the centric relation, the patient had close to an edge-to-edge anterior occlusion (overjet: - 0.5 mm) and the reverse overjet, that was partially caused by an anterior shift of incisors by the patient.





Figure 3 : Pre -op intraoral pictures

The cephalometric analysis also confirmed the Class III malocclusion with maxillary retrognathia as the main cause. The patient was in cervical vertebrae maturation stage 2

Pretreatment cephalometric values (T0) were as follows: **figure 4**

SNA : 79°	SNB : 78°	ANB: 1°
INTERINCISAL ANGLE: 137°	FRANKFORT MANDIBULAR ANGLE : 22°	FRANKFORT MANDIBULAR INCISAL ANGLE: 69°
INCISOR MANDIBULAR PLANE ANGLE: 89°	Y AXIS : 52°	



Figure 4 : Pretreatment cephalogram

Our treatment objective was to correct the sagittal and transverse arch discrepancies through stimulation of maxillary growth ,redirection of mandibular growth; correct the anterior crossbite and to obtain class I molar relationships with correct overbite and overjet along with coincident midline

Different treatment plans were suggested for achieving the treatment objectives: Use of extra-oral appliance (Facemask), deferring treatment and then performing orthognathic surgery after the completion of growth; or to use bimaxillary plates and intermaxillary elastics to protract maxilla.

Treatment progress

The patient was treated using bi-maxillary plates with class III elastics. The clinical protocol for this patient consisted of upper and lower modified Hawley plates with bilateral hooks soldered on the upper molar clasps and on the lower vestibular arch. Bilateral 5/16" intra-oral elastics were used, and patient is asked to wear the appliance for at least 14 hours per day.

Figure 5 .Appliance fitting is checked every 2 weeks and adjusted. The patient is still followed up.



Figure 5 : Hawley-type bi-maxillary plates (BMPs) and Class III elastics attached at the hooks of the upper molar clamps and lower vestibular arch

Modifications to the appliance by Ronsivale V et al., 2023:



Figure 6 : HYRAX expander

To correct the slight posterior crossbite tendency and to achieve more sagittal and transverse correction a HYRAX expander is incorporated into the upper arch appliance and activation schedule was instructed. Figure 6

Results

There was a significant improvement in her overjet with value approaching the normal range after 3 months of active treatment. A 1mm overjet was attained. Soft tissue and skeletal relationship were also improved.



Figure 7 : Post-op intraoral photograph

There is progressive correction of sagittal skeletal relationships, as indicated by an increase in the SNA and ANB angles. There was reduction in the inter-incisal angle

Cephalometric values (T3) after 3 months are as follows:

SNA : 80°	SNB : 78°	ANB: 2°
INTERINCISAL ANGLE: 132°	FRANKFORT MANDIBULAR ANGLE : 22°	FRANKFORT MANDIBULAR INCISAL ANGLE: 68°
INCISOR MANDIBULAR PLANE ANGLE: 90	Y AXIS : 53°	

Discussion:

Treatment approaches determined the achievement of the established clinical outcome, i.e., the correction of the negative overjet along with the re-establishment of physiological mandibular function, by a combination of skeletal and dento-alveolar effects.³ Interceptive treatment of class III malocclusion offers several advantages. It can help prevent the progression of the malocclusion, minimize the need for more invasive treatments, and improve the patient's appearance, self-esteem, and overall oral health. However, the success of interceptive treatment relies on early diagnosis and appropriate treatment timing. The correction of class III in children is generally performed using orthopaedic/functional appliances. Such devices represent the gold standard to control the altered sagittal growth pattern between the maxilla and the mandible.^{4,5} However, children presenting mild class III or pseudo-class III could benefit from simple and less invasive intra-oral devices that can correct the sagittal inter-maxillary discrepancy with less discomfort compared to extra-oral appliances.⁶

Considering the skeletal changes, there was a significant improvement in the anteroposterior relationship between the maxillary and mandibular bases (ANB angle), attributed to a slight increase in the

SNA angle. There was slight labial advancement of the upper incisors and retroclination of the lower incisors. This attributed to a greater dentoalveolar effect, resulting from increased stress on the upper and lower incisors due to the use of class III elastics. The appliance can serve as guide for tooth eruption, promoting the establishment of normal contact. It also causes tipping of the incisors. Compared to facemasks, similar maxillary advancement can be achieved with bimaxillary plate with class III elastics in mild cases with less sutural resistance. In such cases, light forces may generate orthopaedic effects in maxilla close to those obtained with heavy forces.^{7,8} Facemasks often have less patient acceptance due to the bulkiness and the wearing is often procrastinated. However, Facemasks are more versatile since the vector of force can be easily adjusted by sliding the crossbar along the metal vertical bar, instead in this BMP appliances, the point of application of the elastics is firmly localised in the first molars' clasps and the vector of forces cannot be significantly adjusted.³

Conclusion:

BMPs may represent the best choice for those subjects affected by mild form of class III malocclusion, considering the patients' discomfort and treatment acceptance with bulky extraoral appliances.

Bi-maxillary plates promote harmonious restoration of maxillary growth. This treatment successfully achieved the correction of the negative overjet and Class III correction with a combination of skeletal and dento-alveolar effects

Thus, it restores the skeletal and dental harmony.

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From Data to decisions: How AI is transforming periodontal diagnosis and treatment planning applications

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Abstract

This research paper delves into the transformative role of AI in the periodontal treatment planning and diagnosis, focusing on its potential to enhance accuracy, efficiency, and patient outcomes. Periodontal diseases, which affect the supporting structures of teeth, require precise diagnosis and personalized treatment strategies. Traditional methods while effective, are often time consuming and subject to human error. AI driven technologies such as machine learning algorithms, convolutional neural networks (CNN) and computer-aided diagnostic systems, offer innovative solutions by analyzing radiographic images, clinical data and patient histories to identify patterns and predict disease progression. This article discusses the challenges and ethical considerations associated with AI implementation such as data privacy, algorithm bias and the need for interdisciplinary collaborations. The findings underscore the importance of continued innovation and integration of AI technologies in dental practice to improve diagnostic accuracy, treatment efficacy and overall patient care.

Keywords: Artificial intelligence, Periodontitis, Treatment planning, Diagnosis

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Introduction

Periodontitis, a chronic inflammatory disease affecting the periodontal structures, is the sixth most prevalent health condition globally.¹ It begins with gingivitis, caused by biofilm

accumulation, and if untreated, progresses to tooth loss. Periodontitis affects 46% of American adults, with higher rates in the elderly, particularly in industrialized nations. The field of periodontology is evolving, driven by a deeper understanding

of its multifactorial causes and a new 2017 classification system that emphasizes disease severity, complexity, and progression.³ Despite advancements, integrating advanced diagnostics into routine care remains challenging.⁴ Artificial intelligence (AI) has transformed healthcare diagnostics, but its use in periodontology is limited.⁵ This article explores AI's potentials in personalized periodontal diagnostics, aiming to advance research and evidence-based care.⁶

Artificial Intelligence

Artificial Intelligence (AI) is a branch of computer science focused on creating intelligent machines or programs that mimic human intelligence, often with greater speed and accuracy. Machine Learning (ML), a subset of AI, involves building statistical models to classify data, predict outcomes, and identify patterns using methods like regression, decision trees, and support vector machines.⁷ ML is divided into supervised learning (where models learn from labeled data) and unsupervised learning (where models identify patterns without labeled data). Model performance is evaluated using metrics such as accuracy, sensitivity, and F1-score. Deep Learning (DL), a subfield of ML, uses artificial neural networks (ANN) inspired by the human brain to process and learn from data.⁸ Convolutional

Neural Networks (CNN), a type of DL, excel at analyzing complex images by recognizing local patterns through convolutional layers. Alan Turing, an English mathematician, laid the groundwork for artificial intelligence (AI) in the 1950s with his concept of the Turing Test (originally called the Imitation Game), which evaluated a machine's ability to exhibit intelligent behavior indistinguishable from humans. The field of AI was officially born at the 1956 Dartmouth Conference, where John McCarthy coined the term "Artificial Intelligence." In 1955, Allen Newell and Herbert Simon developed the first AI program

In 1959, Arthur Samuel introduced the term "Machine Learning." However, the 1970s brought criticism and financial challenges, leading to the First AI Winter (1970-1980).² The period from 1980 to 1987 saw a resurgence with the rise of expert systems, AI programs designed to solve problems in specific domains using rules derived from expert knowledge. The late 1980s to early 1990s experienced another downturn, known as the Second AI Winter, due to financial setbacks.

In 1997, IBM's Deep Blue became the first computer system to defeat a reigning world chess champion, Garry Kasparov, marking a milestone in AI

development.² By the early 21st century, three key advancements fueled AI progress: access to vast amounts of data, cheaper and faster computing power, and breakthroughs in machine learning techniques like deep learning. These innovations enabled AI to tackle complex problems, transforming industries such as healthcare, finance, and transportation, and reshaping the global technological landscape.

Application in periodontics

1. Patient record maintenance

AI tools like Natural Language Processing (NLP) are revolutionizing periodontal care by streamlining record-keeping and enhancing diagnostics.⁹ NLP interprets unstructured clinical notes, aiding in accurate diagnosis—for example, comparing bleeding on probing (BOP %) with visual inflammation signs. It also analyzes patient feedback to improve treatments and satisfaction. NLP-powered chatbots offer personalized care advice in simple language.¹⁰ By integrating NLP into tasks like charting, periodontist can reduce administrative workloads, optimize workflows, and focus on personalized, patient-centered care

2. Risk Assessment

Periodontitis, a complex disease tied to systemic conditions and influenced

by multiple factors, has been widely studied for its pathophysiology but lacks focus on predictive modeling, limiting personalized risk assessment.¹¹⁻¹² Untreated periodontitis often leads to tooth loss, a major patient concern rarely addressed in research.¹³ Early prediction could enable proactive prevention, reducing physical, emotional, and financial burdens. Current systems, like the new periodontal classification and risk calculators, incorporate factors such as smoking and diabetes, using algorithms to assess risk. Enhancing these models could improve personalized care and patient outcomes.

Recent studies using Artificial Neural Networks (ANN) to predict periodontitis progression have achieved high accuracy (up to 84.2%) by analyzing factors like age, sex, smoking, plaque, BOP, probing depth, and clinical attachment loss.¹⁴⁻¹⁵ While these models perform well, they exclude genetic and multi-omics data (e.g., microbiome, metabolome, proteome), which could reveal critical biomarkers and molecular pathways.¹⁶ Integrating multi-omics data may enhance predictive accuracy, improve personalized risk assessment, and provide deeper insights into periodontitis pathogenesis, advancing precision care in periodontics.

3. Diagnosis and monitoring of periodontal disease

Advanced diagnostics, including comprehensive periodontal exams and imaging, are crucial for periodontal health. Radiography, a noninvasive tool, helps assess bone loss, stage periodontitis, and monitor treatment. AI, though still emerging in periodontology, shows promise in tasks like detecting periodontal bone loss (PBL) and staging disease using Convolutional Neural Networks (CNNs), often matching or surpassing human performance. CNNs have also been used to analyze intra-oral photographs for conditions like gingivitis and plaque, with varying accuracy. These AI advancements enhance diagnostic precision and improve periodontal care.¹⁷

Convolutional Neural Networks (CNNs) are being used to detect and classify dental implants on radiographs, addressing the rise in implant-related complications like peri-implantitis. A Deep Learning (DL) model accurately identified 25 implant systems in just 4.5 minutes, far quicker than dentists or implantologists.¹⁸ ML also aids in immune profiling, using microbial data to group peri-implantitis patients by immunologic profiles for personalized risk assessment and tailored regenerative therapies. These AI tools improve diagnostic accuracy, treatment

precision, and patient outcomes, supporting personalized periodontics.

4. Screening and detection

Traditional periodontal disease diagnosis relies on clinical probing, which is prone to examiner error and often detects disease only after irreversible damage. Early detection is vital. Unlike invasive blood tests, dentists can use noninvasive samples like saliva, GCF, and tongue scrapings, with saliva being the most researched due to its ease of collection and systemic relevance.

Advances in omics technologies (e.g., metabolomics, microbiome, and proteomics) have identified numerous biomarkers, improving our understanding of periodontal disease.¹⁹ However, AI's potential to analyze these datasets remains underutilized. Only a few studies have used AI for salivary biomarker discovery, focusing on metabolome and microbiome analysis. AI-driven approaches, especially integrating multi-omics data, show promise for early detection and personalized care.

Future developments could lead to self-testing kits for periodontal disease risk, similar to pregnancy or COVID-19 tests, using noninvasive samples like saliva or tongue scrapings. Current chair side kits target specific biomarkers, limiting their accuracy compared to a comprehensive

multi-biomarker approach.²⁰ Additionally, smartphone-based image analysis could enable remote oral health monitoring, revolutionizing early detection and personalized periodontal care.

AI-assisted self-monitoring via smartphone images has shown promise in improving post-treatment oral care compliance and periodontal outcomes. Clinical trials are exploring the use of self-recorded intraoral photos for periodontal health assessment.²¹ AI apps can detect gingivitis or poor hygiene from these images, notifying patients and potentially alerting dentists for timely intervention. Early detection encourages better oral hygiene, a cornerstone of periodontal disease prevention. AI-powered tools like smart toothbrushes, which track brushing habits, further enhance patient compliance and effectiveness. Integrating AI-driven tools into periodontology advances personalized care, transforming it from concept to practice and empowering patients and professionals for better oral health.²¹

Advantages and disadvantages

AI brings transformative benefits to healthcare, such as enhanced diagnostic accuracy, standardized treatments, time efficiency, structured data collection, and reduced errors, fostering participatory care.

However, challenges include high setup costs, frequent updates, ethical concerns over medical data usage, and a potential over-reliance on analytical approaches due to limited medical expertise in AI development.² Despite its advancements, AI cannot replace the critical role of physician-patient interaction and clinical skill in modern healthcare.

Integrating AI-based diagnostics into clinical practice offers benefits but also risks, such as errors from poor-quality training data, potentially leading to medico-legal issues. Updating laws to include AI-related clauses can protect professionals and patients.²² AI can also aid in legal cases by documenting data and analyzing procedures, though ethical guidelines are essential.

AI algorithms need large, diverse datasets, but current dental AI research is often small-scale and lacks generalizability due to no representative data. Multi-center studies and benchmarking can address this, though challenges like data accessibility, interoperability, and privacy remain. Solutions include federated learning and international standards.

Effective periodontal treatment requires addressing systemic factors and patient education, not just local procedures. AI can enhance diagnostics and treatment

planning, but its integration must ensure accuracy, fairness, and ethical use.

Future of Artificial Intelligence

Yo-wei Chen et al. predict an AI-Comprehensive Care System for future dentistry. Before appointments, AI reviews patient history, analyzes past radiographs, and evaluates treatments². The AI Patient Manager helps dentists understand patient preferences, while the AI Problem Detector assists in diagnosis, recommends treatments, and provides real-time feedback to minimize errors. It also predicts outcomes.

Dental schools and clinics could use AI to build patient libraries with electronic records, digital X-rays, and tracking data.² 3D intra-oral scans would enable unbiased, distortion-free assessments, offering objective feedback on student performance. AI could also streamline insurance claims, enabling instant approvals for faster, transparent patient care.

Conclusion

In conclusion, personalized diagnostics in periodontology can revolutionize the field by enabling precise diagnoses, customized treatments, and better patient outcomes. As oral healthcare becomes more data-driven, exploring AI's potential and integrating its innovations

into clinical practice is crucial. AI is revolutionizing lives and has a lasting impact. In dentistry, especially periodontics, it offers diverse applications to enhance dental practice beyond traditional methods. Its widespread adoption depends on collaboration among dentists, researchers, and data scientists, as well as financial backing from private and public sectors.

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The Role of Porphyromonas gingivalis in systemic disease

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Abstract

Porphyromonas gingivalis (P. gingivalis) is a Gram-negative, anaerobic bacterium that plays a crucial role in the development of periodontitis. It produces various virulence factors that disrupt both innate and adaptive immunity, enabling its survival, proliferation, and the destruction of periodontal tissue. Beyond periodontal disease, P. gingivalis has been linked to systemic conditions, with insulin resistance serving as a key pathological factor. During various therapeutic procedures P.gingivalis can enter blood and disseminate through it to distant organs. By inducing a systemic inflammatory response, P. gingivalis contributes to metabolic dysfunction. This review aims to explore the mechanisms by which P. gingivalis influences systemic diseases, offering new insights for future research and potential clinical intervention.

Key Words; *Porphyromonas gingivalis, insulin resistance, diabetes, Alzheimer's disease*

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Introduction

P. gingivalis is a Gram-negative, anaerobic bacterium that plays a crucial role in the formation of subgingival plaque biofilm. It is a key member of the red complex, a group of pathogens primarily responsible for chronic inflammation in periodontal disease. It is one of the causative agents that present extremely often in dental plaque and is the main etiological factor in the development of periodontal disease.

Periodontitis is a persistent inflammatory condition that leads to the progressive destruction of periodontal supporting structures, including periodontal pockets, gums, and alveolar bone.¹

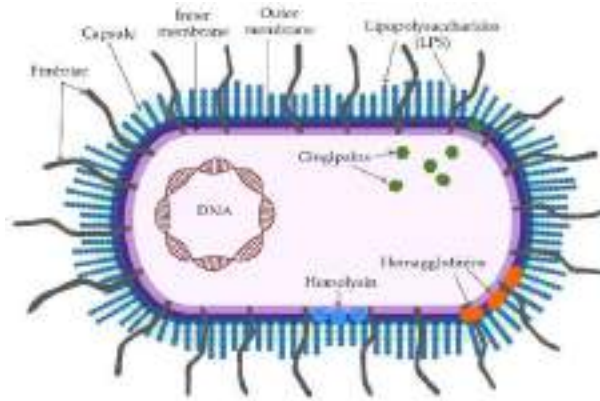


Figure 1:Structure of *P. gingivalis*

As one of the most prevalent oral diseases, periodontitis affects approximately 70% of the global population. If left untreated, it can result in the formation of pockets between the gums and teeth, allowing inflammation to spread and potentially leading to further complications.

Periodontitis has also been identified as a risk factor for several systemic diseases, including **diabetes, atherosclerosis, Alzheimer's disease, non alcoholic fatty liver disease.**² *P. gingivalis* possesses various virulence factors that may influence disease severity, particularly in mixed infections. These factors include **envelope proteins, gingival proteases, fimbriae, hemagglutinin, lipopolysaccharide(LPS), hemolysin, iron uptake transport proteins, toxic outer membrane vesicles, and DNA.**³ By disrupting both innate and adaptive immune responses, these virulence factors enable *P. gingivalis* to evade the host's defense

mechanisms, proliferate, and trigger an inflammatory response. This persistent inflammation can contribute to **insulin resistance** and facilitate the development of systemic diseases.⁴ Research suggests that increased levels of circulating inflammatory factors play a role in insulin resistance, with *P. gingivalis* being linked to systemic conditions where insulin resistance is considered a key pathological mechanism. Additionally, *P. gingivalis* possesses multiple virulence factors that may contribute to disease severity, particularly in cases of mixed infections.

Association of *p. gingivalis* with systemic disease

Diabetes

Type 2 diabetes mellitus (T2DM) is a metabolic disorder and a significant global public health concern. The bidirectional relationship between periodontitis and diabetes is well recognized. Insulin resistance is a key factor in the development of T2DM. *Porphyromonas gingivalis* (*P. gingivalis*), the primary pathogen responsible for periodontitis, has been linked to insulin resistance, potentially contributing to diabetes. A study by Seyama et al. (2020) revealed that outer membrane vesicles released by *P. gingivalis* impaired the glycogen synthase kinase-3 β (GSK-3 β) signalling pathway in

hepatic HepG2 cells. This interference induced insulin resistance, reduced hepatic glycogen synthesis in response to insulin, and ultimately sustained high blood glucose levels.⁵⁻⁷ The co-occurrence of type 2 diabetes and periodontitis significantly worsens both conditions, as inflammation associated with each disease exacerbates the other. *P. gingivalis* has been shown to cause a persistent increase in inflammatory markers linked to type 2 diabetes. The Bacterial endotoxins, particularly lipopolysaccharides (LPS) from infected periodontal sites, can enter the bloodstream and induce endotoxemia.⁸ These endotoxins contribute to systemic inflammation, increasing insulin resistance and accelerating diabetes progression.

Non-Alcoholic Fatty Liver Disease (NAFLD)

Non-alcoholic fatty liver disease (NAFLD) is a metabolic liver disorder closely associated with insulin resistance and genetic predisposition. It is characterized by excessive accumulation of triglycerides in hepatocytes, independent of alcohol consumption. Various risk factors, including metabolic imbalances and immune responses, contribute to its pathogenesis.⁹ Periodontitis is recognized as a risk factor for metabolic disorders, and periodontal bacteria can worsen NAFLD. Endotoxemia triggered by *P. gingivalis* exacerbates NAFLD by increasing insulin resistance and impairing glucose metabolism.

Chronic low-grade inflammation caused by *P. gingivalis* infection disrupts hepatic glucolipid metabolism, leading to lipid accumulation in liver cells. Fatty acid translocase CD36, a crucial metabolic enzyme involved in fatty acid uptake and transport, is widely expressed in cells such as myocytes, monocytes, macrophages, and hepatocytes. Study by Miquilena Colina et al suggests that Inflammation-driven upregulation of CD36 in hepatocytes has been associated with increased hepatic fat accumulation, contributing to NAFLD progression.¹⁰⁻¹² Recent evidence highlights a strong link between NAFLD and dysbiosis of the oral and gut microbiota. Studies by Bajaj et al have shown that oral administration or injection of *P. gingivalis* in mice alters gut microbiota composition, leading to systemic chronic inflammation, insulin resistance, and the development of NAFLD.¹³

Alzheimer's Disease

Alzheimer's disease (AD) is the most common form of dementia, characterized by cognitive decline due to the accumulation of β -amyloid (A β) plaques and neurofibrillary tangles in the brain. Findings from both cross-sectional and longitudinal studies indicate a strong association between periodontitis, cognitive impairment (CI), and Alzheimer's disease. Research by Stein et al. suggests that periodontal disease may contribute to the onset and progression of AD, as elevated serum antibody levels against *P. gingivalis* have been observed in AD patients. A study by Duan et al. (2022a) further identified periodontitis as a

potential risk factor for worsening cognitive dysfunction in AD-like neurodegeneration, possibly due to its impact on insulin signaling pathways, glial proliferation, and neuro inflammation.¹⁴⁻¹⁵ In experimental models, oral infection with *P. gingivalis* has been shown to facilitate bacterial colonization in the brain and trigger AD-like pathology, including complement activation and β -amyloid formation. *P. gingivalis* infection induces neuroinflammation and brain tissue degeneration, contributing to cognitive impairment. Several studies indicate that systemic infections caused by *P. gingivalis* may influence neuroinflammation in the central nervous system.¹⁶ Inflammation is a major factor in insulin resistance and defective insulin signaling, both of which are implicated in the pathogenesis of AD. Dysregulation of brain insulin receptor signaling is increasingly recognized as a key contributor to Alzheimer's disease.

Cardiovascular Disease

Cardiovascular disease (CVD) is the leading cause of mortality in industrialized nations. Clinical and experimental research has demonstrated a strong association between periodontal disease and atherosclerosis (Wallet et al., 2018).¹⁷ Inflammation is the primary factor in the development of atherosclerosis. As a result, chronic periodontal disease is considered a significant risk factor for its progression. Chronic periodontitis, which can fluctuate between stable and acute phases, triggers a persistent but low-grade systemic

inflammatory response that contributes to atherosclerosis. Numerous periodontal pathogens have been identified in human atherosclerotic plaques, with *Porphyromonas gingivalis* (*P. gingivalis*) being the most prevalent bacterial species found in these plaques. During advanced stages of periodontal disease, microorganisms and their byproducts can enter the bloodstream, particularly during dental procedures such as scaling and surgery. Once in circulation, these pathogens can reach distant organs, contributing to various conditions, including subacute endocarditis, and coronary heart disease, atherosclerosis, and ischemic stroke. Oral bacteremia originating from periodontal infections can damage heart valves, increasing the risk of bacterial endocarditis.¹⁸ Among the implicated pathogens, *P. gingivalis* has been identified as a risk factor for prothrombotic conditions, potentially worsening outcomes in patients with atrial fibrillation. Transient oral bacteremia, which can occur during routine dental procedures or daily oral hygiene activities, may serve as a direct route for these bacteria to enter the vascular system. Once in circulation, oral bacteria may invade the endothelium directly or be transported by immune cells to sites of atherosclerotic plaque formation, contributing to systemic inflammation and vascular damage. *P. gingivalis* infection triggers inflammatory pathways and increases the release of inflammatory mediators, which may play a crucial role in the link between periodontitis, cardiovascular disease, and insulin resistance. Lappin et al. found that experimental

administration of Toll-like receptor (TLR) 2 or TLR4 stimulants in mice led to insulin resistance and significantly accelerated atherosclerosis. Interestingly, deletion of the TLR2 or TLR4 genes prevented the development of these conditions in patients with atrial fibrillation.¹⁹

Skeletal Muscle

Skeletal muscle is the body's primary tissue responsible for voluntary movement and posture. Beyond movement, skeletal muscle plays a critical role in maintaining nutritional balance, thermoregulation, endocrine function, energy metabolism, and glucose uptake.²⁰ Approximately 25% of ingested glucose is stored in skeletal muscle as glycogen, which serves as a key energy source.²¹ Insulin resistance and compensatory hyperinsulinemia have become major public health concerns. Myasthenia gravis, characterized by progressive muscle weakness, and sarcopenic obesity, marked by increased body fat and decreased muscle mass, are emerging metabolic disorders associated with aging. The prevalence of skeletal muscle obesity is expected to rise as the elderly population grows. *P. gingivalis* infection contributes to elevated systemic inflammatory mediators, including tumor necrosis factor- α (TNF- α), which promotes insulin resistance and metabolic dysfunction in skeletal muscle.²²

Conclusion

P. gingivalis is the main causative agent of periodontitis, and *P. gingivalis* infection causes

local and systemic inflammation which disrupts local immune defense and releases both *P. gingivalis* and LPS into blood. Based on insulin resistance, *P. gingivalis* can cause systemic diseases such as diabetes, non-alcoholic fatty liver disease, cardiovascular disease, Alzheimer's disease, aggravating the inflammatory response, thereby inducing insulin resistance. Treating periodontitis help reduce the risk or severity of these conditions.

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