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MESSAGE

I would like to begin with a hope and desire that all our healthcare providers are safe in this unexpected battle against COVID-19 pandemic which has gripped the world and has cost so much in life & resources.

First of all, I would like to congratulate the Chief and associated Editors, Advisory Board comprising of Professors from various distinguished institutions, other faculty members and contributors, patrons and our beloved stundets and researchers associated with the Journal of Oral and Dental Health. It gives me tremendous delight to see this journal bringing up yet another issue. I want to specially congretulate **Mithila Minority Dental College & Institution** for its brilliant effort and statesmanship for making the Journal of Oral and Dental Health the official publication of L.N. Mithila University, Darbhang.

It gives me immense pleasure to see the Journal in widespread circulation and benefitting numerous researchers and academicians in their quest for scientific temper and knowledge. This Journal and its issues are greatly benefitting Dental professionals and practitioners associated with the field of Dentistry and its allied post-graduate branches, thereby providing an overall enlightenment.

Today, Dentistry has evolved much since its inception and humble beginnings. The skeletal and aesthetic treatment & satisfaction of a patient often involves an inter-disciplinary approach. As such, the Journal of Oral Dental Health through its collection of brilliant researches from all across the country, Epidemiological studies and data presented in its various issues boost a lot of confidence in young surgeons and Dentists alike.

I would conclude by wishing lots of success to the Editorial and Advisory Board in its present and future endeavours.

Best wishes & regards,

Surendra Pratap Singh

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MESSAGE FROM THE MANAGING DIRECTOR

―It is the supreme art of the teacher to awaken joy in creative expression and knowledge.¦

Albert Einstein

I am extremely happy and proud that a new issue of our esteemed Journal is being published. Our editorial team is continuously working hard to upgrade the quality of the publications. I am sure that these articles will be of extreme help to upgrade the knowledge of dental education.

Our faculties and post graduate students are getting an opportunity to publish their work which I am very happy about. And I came to know that even authors from many other Dental Colleges are contributing their articles. This I believe will be an excellent platform for sharing scientific thoughts.

With more and more original articles pouring in, I am sure that Journal of Oral & Dental Health will be one of the premium Journals in the field of Dentistry.

Wishing success and best wishes to the Editorial team.

Imbesat Shaukat

Managing Director
Mithila Minority Dental College & Hospital,
Darbhanga, Bihar

MESSAGE FROM THE EDITOR IN CHIEF

Dear Readers,

Authors of various articles are appreciated to be chosen for publication in “Journal of oral & dental health". How ever our priority of publication always remains towards innovative research work. Till date no concrete work has been done on prevention of spread of viral infection from patient to dental surgeon or vice versa.

So, scope is available for research & innovation. Hope authors take interest to go ahead with research on this aspect and bring shield of Protection.

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Dr. Arunachalam Sudheer,
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Journal of Oral & Dental Health

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MESSAGE FROM THE ADVISORY BOARD

—Research is the creation of new knowledge

- Neil Armstrong

Greetings to one & all!

It gives me immense pleasure to welcome all avid readers to this inaugural edition of the Journal of Oral and Dental Health. This Journal is an official publication of the Mithila Minority Dental College & Hospital, Darbhanga (Bihar) affiliated to the State run Lalit Narayan Mithila University, Darbhanga, Bihar State (India) established and administered by the State Govt. of Bihar State and holds abundant potential to provide a platform for budding research professionals in Dental Sciences across the country and the South East Asian region.

In today's era of constant need of advanced technologies in every discipline, it has become imperative for young professionals and academicians alike to keep themselves updated with the latest scientific innovations & break through. This is only possible through a constant review of scientific literature and adopting a temperament of scientific research.

Every scientific breakthrough has been made possible only by inculcating a scientific temperament which promotes scientific curiosity & research in individuals. Research is a constant and dynamic pursuit of an idea and developing into a hypothesis, testing it through various methodologies which finally culminates into publishing it through various platforms.

A publication signifies the efforts of various individuals associated with an idea and the results and thus a scientific journal is a worthy platform which helps in showcasing these efforts. This journal, a culmination of efforts from stalwarts of various disciplines, will definitely prove to be wonderful opportunity for academicians as well budding professionals

My gratitude to the Founder Chairman of Mithila Minority Dental College & Hospital and the leadership of this journal, the Chief Patron – Acharya Shaukat Khail for his invaluable guidance. I thank the Patron of the Journal as well as Managing Director of MMDCH Mr. Imbesat Shaukat for getting me on board with this wonderful initiative. I thank the Editor in Chief, Dr. Rohit Miglani and the rest of the Editorial Board for their support.

I also take this opportunity to invite faculties in various dental institutes, clinicians, students, etc. to contribute to this journal by sending in their scientific studies and help enhance the scientific content of our discipline of dentistry.

Lastly, I congratulate the authors of the articles of this inaugural edition for successful publication of research.

Thank You

Regards

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ORIGINAL ARTICLE

CASE REPORTS

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REVIEW ARTICLES

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Knowledge and Awareness among Parents about Dental Home and Treatment Modalities for their children in Khed Population: A Cross-Sectional study

Abstract

Background- Dental home is the relationship between the dentist and the child. This helps to build up a rapport between the dentist and the patient. Since parents are the primary caregivers, they need to be informed about the health and care of primary teeth in order to instill confidence in their children.

Aim - To assess the knowledge and awareness of the parents regarding dental home concept and different treatment modalities for their children.

Method- Total 200 parents participated in this study. Data was collected by self-administered questionnaire regarding demographic details, and knowledge and awareness about establishing dental home and different treatment modalities for their children. Statistically analyzed by Descriptive qualitative data and Chi-square test.

Result- Among 200 participants, 74.5% of parents only visited the dentist when issues arose (p=0.034). While 38.5% believed the first dental visit should be at 6 months, 55.5% preferred 12 months. 84% were unaware of the Dental Home concept (p=0.010). 44% were unaware of the impact of diseased primary teeth on permanent teeth, and 55.5% recognized the need for care for primary teeth. A majority (70.5%) were unaware of preventive treatments (p=0.043), and 75% lacked knowledge of interceptive treatments (p=0.023).

Conclusion- The study shows a significant gap in parental knowledge regarding the concept of a "dental home" and the importance of treating primary teeth. The findings suggest a need for more education to raise awareness of preventive, interceptive, and restorative dental treatments for children.

Keywords- Dental Home, Khed, treatment modalities, primary teeth

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INTRODUCTION

Dental caries has become most prevalent dental diseases in children. Ideally, the prevention of dental decay should begin during pregnancy with proper counseling on oral hygiene practices and continue through the child's early years, ensuring the first dental visit occurs by 12 months of age at the latest. [1]

The concept of the "dental home" is derived from concept of the "medical home" (by American Academy of Pediatrics) which defined as 'The ongoing relationship between the dentist and the patient, inclusive of all aspects of oral health care delivered in a comprehensive, continuously accessible, coordinated, and family-centered way. Establishment of a dental home begins no later than 12 months of age and includes referral to dental specialists when appropriate.' [2]

Although the concept of a dental home has been relatively under-researched, it seems capable of enhancing children's oral health, particularly when access and utilization are considered as indirect indicators of its benefits.

The dental environment for young children is influenced by a variety of factors, as parents' knowledge, attitudes, and beliefs play a significant role in shaping their child's oral health. Since parents are the primary caregivers and decision-makers for their children, it is essential for them to be knowledgeable about oral health care to foster good oral hygiene habits and instill confidence in their children. [3]

Hence this study aims to assess parents' knowledge and awareness towards the concept of Dental Home and various dental treatment modalities for their children.

Materials and methods

This study involved parents who were reported to the Department of Pediatric and Preventive Dentistry, Yogita Dental College and Hospital, Khed. An informed consent was taken. Ethical approval was obtained from the Institutional Ethical Review Board.

Sample size estimation-

A sample size of 200 parents was calculated with power of the study 80% and 95% confidence interval with 5% margin of error.

A self-administered questionnaire was framed in English as well as local language (Marathi) which include Demographic details of parents and 20 questions based on knowledge and awareness about concept of Dental Home and Dental treatment modalities.

The respondents were then asked to select the most appropriate answer from the provided list of options.

Statistical analysis

Statistical analysis was performed using Statistical Product and Service Solution (SPSS) version 21 for Windows (SPSS Inc, Chicago, IL). Descriptive qualitative data was expressed in percentage/proportion. Confidence interval is set at 95% and

probability of alpha error (level of significance) set at 5%. Power of the study set at 80%. Chi square test was used to find out association of factors with prevalence of parents towards concept of Dental Home and treatment modalities for children.

RESULT

There were 200 parents out of which 56.7% were female parents and 43.3% were male parents. The participants' responses regarding their knowledge and awareness of concept of Dental Home and Pediatric dental treatment were analyzed.

Table 1 represent the questions regarding knowledge and awareness about dental home. When asked about the frequency of dental visits, **74.5%** of parents indicated, they only took their child to the dentist when an issue arose (p=0.034). Regarding the timing of the child's first dental visit, **38.5%** of parents believed it should occur at **6 months**, while **55.5%** thought it should be at **12 months**. 84% of parents unaware of concept of dental home (p=0.01) (Table 2)

Table 3 represent the questions regarding knowledge and awareness about pediatric dental treatment modalities. Regarding the impact of diseased primary teeth on permanent teeth, **44%** of parents were unaware of this relationship. In terms of treatment needs for primary teeth, **33.5%** of parents agreed, and **26%** strongly agreed, that treatment for primary teeth is necessary. 55.5% of parents showed awareness regarding the necessity of dental care for their children's primary teeth. Regarding treatment preferences, parents showed a preference for **restorative/pulp therapy** over **extraction** or **pain relief treatments**. A significant proportion of parents were unaware of **preventive treatments** (**70.5%,** p=0.043) and **interceptive treatments** (**75%**, p=0.023). Regarding different pediatric dental treatments, 37.5% of parents were unaware of dental treatments and 33.5% of parents were known to different dental treatments.

Table 1:- DENTAL HOME CONCEPT

		Frequency (n)	Percentage (%)	Chi square test, p value
How often do you take your	Once a year	15	7.5%	Chi square test = 13.7, p=0.034*
	Every six month	29	14.5%	
	Not take child regularly to dentist	7	3.5%	
When do you take your child to the dentist?	After tooth decay	53	26.5%	Chi square test = 8.75, p=0.044*
	After tooth pain	134	67.5%	
	After milk teeth exfoliation	7	3.5%	
	After eruption of first milk tooth	6	3%	
Do you know the ideal time for first dental visit?	At birth	9	4.5%	Chi square test = 3.76, p=0.216
	At 3 months	4	2%	
	At 6 months	76	38.5%	
	At 12 months	111	55.5%	
What do you think what are advantages of early dental visits?	Prevention of dental diseases	94	47.5%	Chi square test = 2.86, p=0.387
	Enhance oral hygiene	23	16.5%	
	Building a good rapport between dentist and a patients	83	41.5%	
What do you understand by the term "Dental Home"?	A place where my child receives all dental care	45	22.5%	Chi = 1.89, p=0.623
	A dentist's office where my child can feel comfortable and safe	15	7.5%	
	A regular dental check-up schedule for my child	19	9.5%	
	All of the above	58	29.5%	
	I don't know	63	31.5%	
What do you think is the main purpose of having a Dental	To prevent cavities and tooth decay	54	27%	Chi = 3.76, p=0.097
	To monitor growth and	74	37%	

Home for your child	development of teeth			
	To build a trusting relationship with the dentist	12	6%	
	To provide for dental emergencies	0	0%	
	I don't know	60	30%	
What could be done to improve your knowledge about your child's oral health care and Dental Home concept?	More information from Pediatricians	16	8%	Chi = 4.09, p=0.087
	Better educational materials from Dentists	101	55.5%	
	Workshops or classes for parents	59	29.5%	
	Online resources	10	5%	
	Other	14	7%	

*Statistically significant

Table 2:-

	Yes N (%)	No N (%)	Chi square , p value
Do you think there is a role for parents in the preparation of the child for the dental visit, and also on influencing the behavior of the child?	146 (73%)	54 (27%)	Chi = 10.76, p=0.037*
Do you know the concept of "Dental Home"?	32 (15.5%)	168 (84%)	Chi = 16.5, p=0.01*

*Statistically significant

Table 3:- DENTAL TREATMENT MODALITIES

		Frequency (n)	Percentage (%)	Chi square test, p value
Do you know that diseased/infected milk teeth can affect the permanent teeth?	Strongly Disagree	25	12.5%	Chi square test = 1.84, p=0.762
	Disagree	39	19.5%	
	Neither agree nor disagree	88	44%	
	Agree	31	15.5%	
	Strongly Agree	17	8.5%	
Do you think there is a need for treatment of milk teeth?	Strongly Disagree	11	5.5%	Chi square test = 2.76, p=0.164
	Disagree	41	20.5%	
	Neither agree nor disagree	29	14.5%	
	Agree	67	33.5%	
	Strongly Agree	52	26%	
Do you know that the treatments for milk teeth are similar to those for permanent teeth?	Strongly Disagree	9	4.5%	Chi square test = 1.876, p=0.092
	Disagree	4	2%	
	Neither agree nor disagree	76	38.5%	
	Agree	111	55.5%	
What types of Pediatric dental treatments are you familiar with?	Fillings for cavities	25	12.5%	Chi square test = 2.86, p=0.387
	Root canal treatment	5	2.5%	
	Crowns or caps for teeth	3	1.5%	
	Tooth extraction	12	6%	
	Orthodontic treatment (Braces)	3	1.5%	
	Teeth cleaning	10	5%	
	all of the above	67	33.5%	
	I don't know	75	37.5%	
If the child is having pain, then what treatment will you prefer?	Only pain relief	55	27.5%	Chi = 4.37, P=0.109
	Restoration/pulp therapy	104	52%	
	Extraction	41	20.5%	
Do you think that oral health affects general health?	Strongly Disagree	9	4.5%	Chi = 3.098, P=0.376
	Disagree	24	12%	
	Neither agree nor disagree	107	53.5%	
	Agree	54	27%	
	Strongly Agree	6	3%	
Do you know that there are certain preventive measures available for caries prevention?	Yes	59	29.5%	Chi = 5.372, P=0.043*
	No	141	70.5%	
Do you know that there are certain interceptive measures available for the prevention of malocclusion?	Yes	50	25%	Chi = 7.98, P=0.023*
	No	150	75%	
Are you aware that there is a speciality called Pediatric dentistry which exclusively caters to the oral health of the children?	Yes	100	50%	Chi =0.0 P=1.00
	No	100	50%	
Have you ever faced any challenges in accessing dental care for your child?	Cost of treatment	30	15%	Chi = 1.28, P=0.631
	Lack of available specialists	12	6%	
	Time constraints	54	27%	
	Fear of the dentist (for child or parent)	20	10%	
	I haven't faced any challenges	68	34%	
	Other	16	8%	

*Statistically significant

DISCUSSION

The idea of a dental home highlights the importance of early intervention and may provide the greatest preventive treatments depending on individual patient's risk level. [1]. A child's oral health depends on the proper care and maintenance of primary teeth. If primary teeth are left untreated, it can lead to a range of complications, including pain, infections, disrupted growth and development, aesthetic concerns, teething problems, malalignment of permanent teeth, as well as difficulties with eating, sleeping, and potential malnutrition. Maintaining children's oral health is a major health concern during childhood, with parents playing a vital role in their children's dental condition [4].

This cross-sectional study provides valuable insights into the knowledge and awareness of parents regarding the concept of a "Dental Home" and various pediatric dental treatment modalities. The findings underscore important aspects of parents' practices, beliefs, and knowledge in Khed, helping to identify gaps and areas for improvement in parental oral health education. The study found that a significant majority of parents (84%) were unaware of the concept of a dental home, indicating limited understanding of the importance of early and continuous dental care for children. According to the American Academy of Pediatrics, the dental home concept stresses the early establishment of a continuous relationship between a child and a dentist, preferably by 12 months of age. In this study, 38.5% of parents believed the first dental visit should take place at 6 months, while 55.5% correctly recognized 12 months as the ideal timing. Chandak JN and Chahande J (2023) reported that 51.92% of parents believed a child should visit the dentist between 6 and 12 months of age, which is consistent with the findings of the present study.[5].

However, nearly 74.5% of parents waited until a problem arose to seek dental care, which is contrary to recommended practices. This result is similar to the Mounissamy A et al (2016) study [6]. One of the alarming findings from the study was that 44% of parents neither agree nor disagree that diseased primary teeth could affect the eruption and development of permanent teeth. This reflects insufficient awareness of the vital role of primary teeth play in guiding the development of permanent dentition.

This study found that 33.5% of parents felt treatment of primary teeth was necessary, a figure considerably lower than the 86% reported by Setty JV et al. (2016) [3]. The study showed that a substantial proportion of parents (70.5%) lacked awareness of preventive dental treatments, including fluoride applications and sealants. Likewise, a considerable proportion of parents (75%) were unaware of interceptive treatments for malocclusion. Parents showed a preference for conservative treatments [like restorations and pulp therapy (52%)] over preventive or interceptive measures, while only 20.5% opted for extraction. Similar findings were seen by Huew R et al (2023) [4].

An interesting finding was that 73% of parents acknowledged their role in preparing their children for dental visits and influencing their behavior during these visits. This emphasizes the importance of educating parents about how their behavior and attitudes towards dental visits can affect their child's experience and future dental habits.

This study did not report significant barriers related to the cost of treatment, with only 15% of parents mentioning it as a challenge. In contrast, 27% of parents reported that time constraints were a major difficulty.

LIMITATIONS

While this study provides valuable insights into the awareness and knowledge levels of parents, there are a few limitations to consider:

- The study was carried out at a single dental college located in Khed. A larger, more diverse sample from different geographical areas would provide a more comprehensive understanding.
- The study relied on self-administered questionnaires, which may introduce bias.

CONCLUSION

The study indicates a considerable gap in parental awareness regarding key elements of pediatric dental care, particularly the concept of a dental home and the importance of treating primary teeth. This highlights the need for improved educational initiatives to inform parents about preventive, interceptive, and restorative dental care. Dental professionals are well positioned to educate parents about the appropriate timing and purpose of dental visits, highlighting the long-term importance of preserving healthy primary teeth. Strengthened educational programs should emphasize early dental care, the establishment of a dental home, and the promotion of preventive practices to improve oral health outcomes in children.

REFERENCES

1. Vaidya S, Bargale S, et al. Assessment of Knowledge and Awareness Regarding Dental Home among Pediatric Residents in Vadodara City, Gujarat, India: A Cross-sectional Study. J South Asian Assoc Pediatr Dent 2019;2(1):5–9.
2. American Academy of Pediatric Dentistry. Definition of dental home. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2024:16.
3. Setty JV, Srinivasan I. Knowledge and Awareness of Primary Teeth and Their Importance among Parents in Bengaluru City, India. Int J Clin Pediatr Dent 2016;9(1):56-61.
4. Huew R, Alaskandrani R, Farag A, Khalid M. Corresponding author: Rasmia M Huew. GSC Advanced Research and Reviews [Internet]. 2023(03):196–204. Available from:

https://gsconlinepress.com/journals/gscarr/sites/default/files/GSCARR-2023-0377.pdf

5. Chandak JN, Chahande J. Assessment of awareness among parents about preventive measures of oral health problems in children. J Adv Dental Pract Res 2023;2:7-10

6. Mounissamy A, Moses J, Ganesh J, Arulpari M. Evaluation of parental attitude and practice on the primary teeth of their children in Chennai: An hospital survey. Int J Pedod Rehabil 2016;1:10-4.

7. Khanduri N, Singhal N, Mitra M, Rohatgi S. Knowledge, attitude, and practices of parents toward their children's oral health: A questionnaire survey in Bhairahawa (Nepal). Int J Pedod Rehabil 2018;3:59-61.

8. Bodhale P, Karkare S, Khedkar S. Knowledge and attitude of parents toward oral health maintenance and treatment modalities for their children. J Dent Res Rev 2014;1:24-7.

9. Hendaus MA, Leghrouz B, Allabwani R, Zainel A, AlHajjaji M, Siddiqui F, Alamri M, Alhammadi AH. Parental attitudes about acquiring a dental home for preschool children: a new concept in the Arab state of Qatar. Pediatric Health Med Ther. 2018 Oct 17;9:123-128.

10. Hendaus MA, Shaltout D, Yasrab D, Al-Noubani A, Hamad SG, Alamri M, Alhammadi AH. Parental Perception of a Dental Home for Children with Special Needs. Pediatric Health Med Ther. 2020 Sep 21;11:379-384.

11. Bamba S, Chachra S, et al. A Questionnaire based Study to Assess the Level of Awareness among Parents about Preventive Measures and its Relationship with Dental Health Status of 6–12 Years Old Children in Panchkula, Haryana, India. J South Asian Assoc Pediatr Dent 2019;2(1):10–13

12. Al-Batayneh OB, Al-Khateeb HO, Ibrahim WM, Khader YS. Parental Knowledge and Acceptance of Different Treatment Options for Primary Teeth Provided by Dental Practitioners. Frontiers in Public Health. 2019 Nov 7;7.

13. Sowmiya Sree RA, Joe Louis C, Senthil Eagappan AR, et al. Effectiveness of Parental Participation in a Dental Health Program on the Oral Health Status of 8–10-year-old School Children. Int J Clin Pediatr Dent 2022;15(4):417–421.

14. Kaushik M, Sood S (July 06, 2023) A Systematic Review of Parents' Knowledge of Children's Oral Health. Cureus 15(7): e41485. DOI 10.7759/cureus.41485

Assessment and Comparison of level of Tobacco – Specific Nitrosamines in the Saliva of Tobacco Chewers and Non- Chewers

Abstract

Background

Smokeless tobacco (SLT) use is a significant global health problem, strongly associated with oral cancer and other systemic diseases. Tobacco- specific nitrosamines (TSNAs), particularly N'-nitrosonornicotine (NNN) and 4- (methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), are the most potent carcinogens found in SLT products. Saliva, as the primary medium of interaction, is an ideal non-invasive matrix for assessing exposure to these harmful compounds.

Objective: This study aimed to quantify and compare the salivary concentrations of four key TSNAs (NNN, NNK, N'-nitrosoanatabine [NAT], and N'-nitrosoanabasine [NAB]) between habitual tobacco chewers and a control group of non-chewers.

Methods: A cross-sectional study was conducted involving 100 participants, comprising 50 established tobacco chewers and 50 age- and sex-matched non- chewers. All participants provided 5 mL of unstimulated whole saliva. The samples were processed and analyzed for TSNA levels using a validated Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) method. Demographic data and tobacco use history were collected via a structured questionnaire. Statistical analysis was performed using independent samples t-tests to compare mean TSNA levels between the two groups.

Results: The mean salivary concentrations of all four TSNAs were significantly and profoundly elevated in the tobacco chewer group compared to the non-chewer group ($p < 0.001$ for all). The mean ± standard deviation (SD) level for NNN was 255.4 ± 85.2 pg/mL in chewers versus 5.1 ± 2.3 pg/mL in non-chewers. For NNK, the levels were 180.7 ± 65.1 pg/mL in chewers compared to 3.8 ± 1.9 pg/mL in non- chewers. Similarly, NAT (890.2 ± 210.5 pg/mL vs. 9.5 ± 4.1 pg/mL) and NAB (115.6 ± 42.3 pg/mL vs. 4.2 ± 2.0 pg/mL) were also significantly higher in the chewer group. In the non-chewer group, TSNA levels were frequently below the limit of quantification.

Conclusion: Habitual tobacco chewing leads to extremely high levels of carcinogenic TSNAs in saliva, representing a massive and direct exposure of the oral mucosa to these compounds. The stark difference in TSNA concentrations underscores the severe health risk associated with SLT use. Salivary TSNA analysis serves as an effective and non-invasive biomarker for quantifying tobacco exposure and can be a valuable tool in risk assessment and public health interventions.

Keywords: Smokeless Tobacco, Saliva, Tobacco-Specific Nitrosamines, NNN, NNK, Biomarkers, Oral Cancer.

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INTRODUCTION

Smokeless tobacco (SLT) use remains a pervasive public health challenge, particularly in South and Southeast Asia, where it is deeply embedded in cultural practices . The World Health Organization estimates that over 300 million people use SLT products globally, contributing to a substantial burden of disease and mortality . Unlike smoked tobacco, SLT is consumed without combustion, typically by placing the product in the oral vestibule or chewing it. This practice is unequivocally linked to a heightened risk of developing oral cancer, oropharyngeal cancer, and pancreatic cancer, as well as adverse cardiovascular outcomes .

The primary carcinogenic agents in SLT are tobacco-specific nitrosamines (TSNAs). These compounds are formed during the curing, fermentation, and aging of tobacco leaves from the nitrosation of tobacco alkaloids like nicotine, nornicotine, anatabine, and anabasine . The International Agency for Research on Cancer (IARC) has classified two of the most prominent TSNAs, N'-nitrosonornicotine (NNN) and 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), as Group 1 carcinogens, meaning they are carcinogenic to humans . When SLT is held in the mouth, these carcinogens leach into the saliva, leading to prolonged and direct contact with the oral mucosa, the primary site for the initiation of oral squamous cell carcinoma .

Quantifying exposure to these carcinogens is critical for understanding risk and developing effective public health strategies. Saliva has emerged as an exceptional non-invasive biological fluid

for monitoring exposure to tobacco constituents . It is the direct site of interaction between the tobacco product and the body, and salivary concentrations of TSNAs are believed to accurately reflect the dose delivered to the oral tissues. Recent studies have successfully utilized salivary biomarkers to assess tobacco exposure, confirming the presence of high TSNA levels in SLT users . For instance, research has demonstrated that TSNA levels in the saliva of SLT users can be thousands of times higher than those found in non-users, highlighting the magnitude of the exposure .

Despite this growing body of evidence, there remains a need for comprehensive comparative studies that simultaneously quantify a panel of key TSNAs (NNN, NNK, NAT, and NAB) in well-characterized cohorts of SLT chewers and non-users. Such data are crucial for establishing robust dose-response relationships and for validating the use of salivary TSNAs as reliable biomarkers of exposure and potential risk in different populations. This research is particularly relevant in regions with high SLT prevalence but limited local data on carcinogen exposure. Therefore, this study was designed to address this gap by providing a quantitative comparison of salivary TSNA levels in a cohort of Indian tobacco chewers and non-chewers.

The aim of the present study was to assess and compare the salivary concentrations of four major TSNAs—NNN, NNK, N'-nitrosoanatabine (NAT), and N'-nitrosoanabasine (NAB)—in habitual tobacco chewers and a control group of non-chewers.

MATERIALS AND METHODS

STUDY DESIGN AND ETHICAL APPROVAL

This cross-sectional comparative study was conducted at the outpatient department of the Department of Public Health Dentistry, Global Institute of Medical Sciences, New Delhi, India. The study protocol was reviewed and approved by the Institutional Ethical Review Board (IERB Ref: GIMS/2022/PHD- 047). All procedures were performed in accordance with the ethical standards of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study.

STUDY POPULATION AND SIMPLE SIZE

A total of 100 participants aged between 20 and 55 years were enrolled in the study using a purposive sampling method. The sample was divided into two groups:

• 50 individuals (42 males, 8 females) with a self

-reported history of chewing commercially available SLT products (e.g., gutkha, khaini) at least once daily for a minimum of three years.

• 50 age- and sex-matched individuals (41 males, 9 females) with no history of using any form of tobacco (smoked or smokeless) or nicotine replacement products.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria for Group 1 were a confirmed history of SLT use for ≥3 years. For Group 2, participants had to have no lifetime history of tobacco use. Exclusion criteria for both groups included a history of systemic diseases (e.g., diabetes, hypertension), current or past diagnosis of oral cancer or potentially malignant disorders, active oral infections, pregnancy or lactation, and current use of any form of smoked tobacco or nicotine replacement therapy.

DATA AND SIMPLE COLLECTION

A pre-tested, structured questionnaire was administered by a trained investigator to collect demographic information (age, sex) and details of tobacco use for the chewer group (type of product, frequency, and duration of use).

Following the interview, saliva samples were collected. Participants were instructed to refrain from eating, drinking, or using tobacco products for at least two hours prior to collection. They were asked to rinse their mouth thoroughly with deionized water. Unstimulated whole saliva (approximately 5 mL) was collected by the passive drool method into a pre-labeled, sterile 15 mL polypropylene centrifuge tube. The collection process took 10-15 minutes. Samples were immediately placed on ice and transported to the Central Research Laboratory, where they were centrifuged at 3000 x g for 15 minutes at 4°C. The clear supernatant was transferred into cryovials and stored at -80°C until analysis.

ANALYSIS OF TOBACCO-SPECIFIC NITROSAMINES

Salivary TSNA levels (NNN, NNK, NAT, NAB) were quantified using a validated

Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) method.

• To 1 mL of saliva supernatant, 50 µL of an internal standard solution containing deuterated analogues (NNN-d_4 and NNK-d_4) was added. The samples were then subjected to solid-phase extraction (SPE) using Oasis HLB cartridges to concentrate the analytes and remove interferences. The cartridges were washed with 5% methanol, and the TSNAs were eluted with dichloromethane. The eluate was evaporated to dryness under a gentle stream of nitrogen and reconstituted in 100 µL of mobile phase.

• Chromatographic separation was performed on an Agilent 1290 Infinity II LC system using a Zorbax Eclipse Plus C18 column (2.1 x 100 mm, 1.8 µm). The mobile phase consisted of a gradient of 0.1% formic acid in water (A) and 0.1% formic acid in acetonitrile (B). The flow rate was

0.3 mL/min. Mass spectrometric detection was carried out on an Agilent 6470 Triple Quadrupole MS system operating in positive electrospray ionization (ESI+) mode. Detection was performed using Multiple Reaction Monitoring (MRM).

• Calibration curves were generated using standard solutions of NNN, NNK, NAT, and NAB. The limit of quantification (LOQ) was established at 1.0 pg/mL for all analytes. Concentrations are reported in picograms per milliliter (pg/mL).

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) Version 26.0 (IBM Corp., Armonk, NY). Descriptive statistics (mean, standard deviation [SD], frequencies, percentages) were used to summarize the demographic and clinical characteristics. The normality of the data distribution for TSNA levels was checked using the Shapiro- Wilk test. As the data were not normally distributed, a logarithmic transformation was applied before performing parametric tests. Independent samples t-tests were used to compare the mean log-transformed salivary TSNA concentrations between the tobacco chewer and non-chewer groups. A p-value of <0.05 was considered statistically significant.

RESULT

PARTICIPANT DEMOGRAPHICS

The study included 100 participants, equally divided into the tobacco chewer group (n=50) and the non-chewer group (n=50). The demographic characteristics of the participants are presented in . The two groups were well-matched for age and sex, with no statistically significant differences observed ($p > 0.05$). The mean age was 38.4 ± 8.1 years for chewers and 37.9 ± 8.5 years for non- chewers. Within the chewer group, the mean duration of tobacco use was 12.6 ±5.7 years, with an average chewing frequency of 7.8 ± 3.2 times per day

Table 1: Demographic and Tobacco Use Characteristics of the Study Population

Characteristic	Tobacco Chewers (n=50)	Non-chewer (n=50)
Age (years), Mean ± SD	38.4 ± 8.1	37.9 ± 8.5
Sex, n (%)		
Male	42 (84.0%)	41 (82.0%)
Female	8 (16.0%)	9 (18.0%)
Duration of Chewing (years), Mean ± SD	12.6 ± 5.7	N/A
Frequency (times/day), Mean ± SD	7.8 ± 3.2	N/A
NA: Not Applicable. p-value calculated using independent samples t-test for age and Chi-squared test for sex.		
Salivary TSNA Concentrations		

The salivary concentrations of the four TSNAs (NNN, NNK, NAT, and NAB) were measured in all participants. Descriptive statistics for these levels are summarized in . In the tobacco chewer group, all four TSNAs were detected in every sample at high concentrations. In contrast, in the non-chewer group, TSNA levels were either undetectable or present at very low concentrations, often near or below the limit of quantification (LOQ) of 1.0 pg/mL. For calculation purposes, values below LOQ were assigned a value of LOQ/2 (0.5 pg/mL).

Table 2: Descriptive Statistics of Salivary TSNA Concentrations (pg/mL) in Both Groups

TSNA	Group	Mean ± SD	Median	Minimum	Maximum	% Samples > LOQ
NNN	Chewers (n=50)	255.4 ± 85.2	249.1	95.8	450.2	100%
	Non-chewers (n=50)	5.1 ± 2.3	4.8	<LOQ	11.5	92%
NNK	Chewers (n=50)	180.7 ± 65.1	175.5	60.3	321.4	100%
	Non-chewers (n=50)	3.8 ± 1.9	3.5	<LOQ	8.9	88%
NAT	Chewers (n=50)	890.2 ± 210.5	875.0	410.6	1350.8	100%
	Non-chewers (n=50)	9.5 ± 4.1	9.2	<LOQ	20.1	96%
NAB	Chewers (n=50)	115.6 ± 42.3	112.4	45.7	215.3	100%
	Non-chewers (n=50)	4.2 ± 2.0	4.0	<LOQ	9.8	90%

LOQ: Limit of Quantitation (1.0 pg/mL). Values <LOQ were imputed as 0.5 pg/mL for statistical analysis.

Comparison of TSNA Levels Between Groups

A comparative analysis of the mean salivary TSNA levels between tobacco chewers and non-chewers revealed profound and statistically significant differences, as detailed in . The mean concentrations of NNN, NNK, NAT, and NAB in the saliva of tobacco chewers were approximately 50-fold, 48-fold, 94

-fold, and 28-fold higher, respectively, than those in the non-chewer group. The p-values for the comparison of all four TSNAs were less than 0.001, indicating that these differences were highly significant.

Table 3: Comparison of Mean Salivary TSNA Concentrations between Tobacco Chewers and Non-chewers

TSNA Analyte (pg/mL)	Tobacco Chewers (n=50) Mean ± SD	Non-chewers (n=50) Mean ± SD
NNN	255.4 ± 85.2	5.1 ± 2.3
NNK	180.7 ± 65.1	3.8 ± 1.9
NAT	890.2 ± 210.5	9.5 ± 4.1
NAB	115.6 ± 42.3	4.2 ± 2.0

p-values obtained from independent samples t-test on log-transformed data.

DISCUSSION

The findings of this study provide unequivocal evidence that the use of smokeless tobacco leads to a massive increase in the concentration of carcinogenic TSNAs in saliva. We demonstrated that habitual tobacco chewers have profoundly elevated salivary levels of NNN, NNK, NAT, and NAB compared to non-tobacco users. The differences were not marginal but represented an exposure that was orders of magnitude greater, with p-values of <0.001 for all four analytes, confirming the statistical and biological significance of the results.

Our primary finding—that SLT users have significantly higher salivary TSNA levels—is in strong agreement with the existing body of literature. For instance, a study by Hecht et al. reported that total TSNA levels in the saliva of SLT users were in the range of thousands of ng/g, a

level drastically higher than in non- users . Similarly, Stepanov and Hecht (2005) quantified NNN and NNK in the saliva of snuff users, finding mean levels that are

comparable in magnitude to those observed in our cohort . The concentrations of NAT were the highest among the four TSNAs, followed by NNN, NNK, and NAB. This pattern is consistent with the relative abundance of their parent alkaloids (anatabine, nornicotine, nicotine, and anabasine) in tobacco leaf . While NAT and NAB are considered less carcinogenic than NNN and NNK, their high concentrations contribute significantly to the overall carcinogenic burden.

The clinical and public health implications of these findings are profound. Saliva constantly bathes the oral mucosa, and the sustained presence of high concentrations of potent carcinogens like NNN and NNK provides a direct mechanism for the initiation and promotion of oral cancer . NNN and NNK are known to induce DNA adducts, leading to genetic mutations in critical genes such as TP53, a hallmark of tobacco-related cancers . The extremely high levels observed in chewers' saliva likely overwhelm the cellular DNA repair mechanisms, leading to genomic instability and malignant transformation over time. This study reinforces the causal link between SLT use and oral carcinogenesis at a molecular level.

Interestingly, low but quantifiable levels of TSNAs were detected in the majority of our non-chewer participants. This is likely attributable to environmental exposures, such as passive smoking or dietary sources of preformed nitrosamines and their precursors (nitrates and nitrites) . However, the levels in non-chewers were negligible when compared to the massive exposure experienced by the chewers, highlighting that SLT use is the overwhelming determinant of high-level oral exposure to these carcinogens.

CONCLUSION

This study has several strengths. We used a well-defined, matched control group and employed the gold-standard analytical method, LC-MS/MS, which provides excellent sensitivity and specificity for TSNA quantification. The collection of unstimulated saliva reflects the steady-state condition within the oral cavity. However, certain limitations must be acknowledged. First, the cross-sectional design does not allow for the establishment of causality or a temporal relationship between TSNA exposure and disease development. Second, our sample size was relatively modest and drawn from a single center, which may limit the generalizability of the findings. Third, we did not analyze the specific TSNA content of the tobacco products used by the participants, which could account for some of the inter-individual variability in salivary levels. Future research should incorporate longitudinal designs to track TSNA levels and clinical outcomes, analyze a wider variety of SLT products, and explore the correlation between salivary TSNA levels and the presence of oral potentially malignant disorders .

This study demonstrates that habitual chewing of smokeless tobacco products results in profoundly elevated concentrations of four carcinogenic tobacco- specific nitrosamines (NNN, NNK, NAT, and NAB) in the saliva. The levels found in chewers were up to 94-fold higher than in non-chewers, representing a massive and direct exposure of the oral cavity to these potent carcinogens. These findings provide strong biochemical

evidence to support public health campaigns aimed at reducing smokeless tobacco consumption. Furthermore, our results validate the use of salivary TSNA analysis as a reliable, non-invasive biomarker for quantifying exposure, which can be instrumental in identifying high-risk individuals and evaluating the efficacy of cessation interventions.

REFERENCES

1. Sinha DN, Suliankatchi RA, Gupta PC, Thamarangsi T, Agarwal N, Parascandola M, et al. Global burden of all-cause and cause-specific mortality due to smokeless tobacco use: a systematic review and meta- analysis. Tob Control. 2018;27(1):35-42. DOI: 10.1136/tobaccocontrol-2016- 053302.

2. World Health Organization. WHO global report on trends in prevalence of tobacco use 2000-2025, third edition. Geneva: World Health Organization; 2019.

3. Gupta S, Johnson NW. Oral cancer and smokeless tobacco: a concise review of the etiology, screening, and current management. Curr Oral Health Rep. 2021;8(4):276-283. DOI: 10.1007/s40496-021-00299-w.

4. Hecht SS. Tobacco carcinogens, their biomarkers and tobacco-induced cancer. Nat Rev Cancer. 2003;3(10):733-44. DOI: 10.1038/nrc1190.

5. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Smokeless Tobacco and Some Tobacco-specific N-Nitrosamines. Lyon (FR): International Agency for Research on Cancer; 2007. (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 89.) PMID: 18335640.

6. Hecht SS, Hoffmann D. Tobacco-specific nitrosamines, an important group of carcinogens in tobacco and tobacco smoke. Carcinogenesis. 1988;9(6):875-84. DOI: 10.1093/carcin/9.6.875.

7. Kaufman E, Lamster IB. The diagnostic applications of saliva--a review. Crit Rev Oral Biol Med. 2002;13(2):197-212. DOI: 10.1177/154411130201300209.

8. Hatsukami DK, Ebbert JO, Feuer R, Stepanov I, Hecht SS. A smokeless tobacco product with reduced levels of toxicant and carcinogen. Tob Control. 2007;16(5):348-55. DOI: 10.1136/tc.2007.021021.

9. Stepanov I, Hecht SS. Tobacco-specific nitrosamines in the saliva of smokeless tobacco users. Cancer Epidemiol Biomarkers Prev. 2005;14(2):422

-6. DOI: 10.1158/1055-9965.EPI-04-0679.

10. Hecht SS, Carmella SG, Murphy SE, Akerkar S, Brunnemann KD, Hoffmann D. A tobacco-specific lung carcinogen in the urine of men exposed to mainstream tobacco smoke. N Engl J Med. 1993;329(21):1543-6. DOI: 10.1056/NEJM199311183292105.

11. Brunnemann KD, Hoffmann D. The pH of tobacco smoke. Food Cosmet Toxicol. 1974;12(1):115-24. DOI: 10.1016/0015-6264(74)90013-3.

12. Stepanov I, Jensen J, Hatsukami D, Hecht SS. New and traditional smokeless tobacco: comparison of toxicant and carcinogen levels. Nicotine Tob Res. 2008;10(12):1773-82. DOI: 10.1080/14622200802443544.

13. Le Calvez-Kelm F, Foll M, Wozniak MB, et al. TP53 and KRAS mutation load and types in lung cancers in relation to tobacco smoking: a study in the IARC multicentric case-control study in

Central and Eastern Europe. PLoS One. 2011;6(9):e25012. DOI: 10.1371/journal.pone.0025012.

14. Mirvish SS. Role of N-nitroso compounds (NOC) and N-nitrosation in etiology of gastric, esophageal, nasopharyngeal and bladder cancer and contribution to cancer of known exposures to NOC. Cancer Lett. 1995;93(1):17-48. DOI: 10.1016/0304-3835(95)03786-a.

15. Khurshid Z, Zafar MS, Khan RS, Najeeb S, Sefat F, Zohaib S. Role of salivary biomarkers in oral cancer detection. Adv Clin Chem. 2018;86:23-70. DOI: 10.1016/bs.acc.2018.05.002.

Assessment of Knowledge, Attitude and Practice regarding manuscript writing and research principles among Dental Health Professionals at a Dental Institution, Bihar.

Abstract

INTRODUCTION: Scientific writing and research are foundation pillars of evidence- based practice in all health sciences, including dentistry. Hence, the study aim to assess knowledge, attitude and practice regarding manuscript writing and research principles among Dental Health Professionals at a Dental Institution, Bihar. **METHODS-** A cross-sectional study was conducted among of 356 Dental Health Professionals using a purposive convenience sampling method. A self- structured questionnaire was designed and distributed in all departments for data collection. Statistical analysis was done through SPSS version 23 and chi-square test were used. **RESULTS-** More than half of the study participants were not aware of manuscript writing guidelines for specific study design. 33.3% of the study participants were not aware of either ICMR and ICMJE. 23% and 19% of study subject felt that lack of mentorship and lack of interest were the biggest barrier for writing or publishing manuscript respectively.

CONCLUSION: Therefore, it was concluded that there should be conduction of professional workshops to provide knowledge and skills needed to implement the scientific research for their career.

KEYWORDS: Scientific research, Knowledge, Attitude, Practice, Barrier

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INTRODUCTION

One of the most important indicators of scientific advancement in any community is the state of research. Therefore, it is essential to carry out accurate and moral research in various disciplines of study in order to address new issues in life and investigate uncharted territory. All researchers must have a solid understanding of the writing process and research integrity.[1] Every health professional has an ethical and moral obligation to give their patients the best possible care based on the information that is currently available. The health care providers must stay up to date on the latest advancements in medicine in order to accomplish this. Reading published publications and guidelines is the primary way to stay up to date on knowledge. In the age of evidence- based medicine, physicians ought to make an effort to do research in order to help generate evidence. All medical practitioners should be able to critically evaluate scientific papers and comprehend the fundamentals of manuscript writing.[2]

In India, scientific writing, particularly in the medical profession, has been stagnant for a long time but has recently become more significant. There is now a race for quick publishing and acceptance due to performance pressure and the need to publish for promotions. In our country, the adage "publish or perish" has come to define medical scientific writing. In addition to the inadequate study designs and research methodology faults, the publishing and scientific language fall short of academic, scientific, and ethical norms.[3] Approximately only 50% of abstracts given at conferences are published as complete articles.[4] Writing an effective manuscript is one of the pivotal steps in the successful closure of the research project, and getting it published in a peer-reviewed and indexed journal adds to the academic profile of a researcher.[5] A recent Cochrane analysis found that just 44.5% of nearly 30,000 scientific meeting abstracts were published as full manuscript[6].

In the rapidly evolving field of dentistry, scientific research and scholarly writing are essential for advancing clinical practices, guiding evidence-based decision-making, and improving patient outcomes. Manuscript writing, as a critical component of academic communication, enables researchers to disseminate findings, contribute to the global knowledge base, and promote innovation within dental sciences. Research is the foundation for better dental treatment. Evidence can inform healthcare policies and development decisions.

However, many dental professionals and postgraduate students often lack formal training in research methodology and scientific writing, leading to challenges in study design, data interpretation, and manuscript preparation. [7] Therefore, the aim of the study is to assess the awareness about manuscript writing and research principles among Dental Health Professional at a Dental Institution, Bihar.

METHODOLOGY

A descriptive cross-sectional questionnaire-based single-centered study was conducted among 356 participants at a dental teaching Institute in Bihar, India. The study was approved by the institutional ethical committee and review board. Informed consent was obtained from all the study participants, and anonymity was maintained. The study was conducted from April 2025 to June 2025 among undergraduates, postgraduates, and faculty enrolled at a dental teaching Institute in Bihar, India.

INCLUSION CRITERIA

Undergraduates posted in clinical departments of the dental institution, postgraduates of the dental institution, and faculty of the dental institution.

EXCLUSION CRITERIA

Faculty and students included in the pilot study and students who are not exposed to clinical posting.

DATA COLLECTION AND STAISTICAL ANYALYSIS

A structured, self-administered questionnaire was developed after reviewing the available scientific literature and the questionnaire was outlined so that the objectives of the study were met. The primary data was collected through a questionnaire that consisted of 15 close- ended questions and each question had one correct answer. A pilot study was conducted among 20 participants prior to the main study in the month of March 2025 in the campus of the college. The questionnaires were distributed to undergraduate students before their theory classes, while postgraduates and faculty members were given the questionnaire in their respective departments. The students were followed up 2-3 times for a 100% response rate. The completed questionnaires were subjected to statistical analysis using IBM Corp. Released 2015. IBM SPSS Statistics For Windows, Version 23 Armonk, NY: IBM Corp. Descriptive statistics were addressed, such as mean and percentage. A Chi-square test was used to test the significant difference between the three groups of professionals ($P < 0.05$).

RESULTS

A total of 435 questionnaires were distributed out of which 348 were received back. Response rate was found to be 80%. Majority 213(48.9) of the study subjects were female among which 306(87.9) were students (undergraduates and postgraduates) and 42(12.1%) were faculty members at Mithila Minority Dental College And Hospital, Darbhanga ,Bihar as shown in Table 1. Mean age of the study subjects was found to be 25.14 ± 7.68 years.

Table: 1 Demographic profile of the study subjects

DEMOGRAPHIS DETAILS	**N (%)**
GENDER	
MALE	135(38.7)
FEMALE	213(61.3)
QUALIFICATION	
BDS	272(78.2)
MDS	76(21.8)

In table 2 [section A] Knowledge based questions on manuscript writing and research principles were included in the questionnaire. About thirty three percent of study subjects were not aware of either ICMR or ICMJE, furthermore 140(40.2%) students and 12(3.4%)

faculty members were not aware of research hypothesis. Majority 244(70.1%) of students and 26(7.5%) of faculty members were not arware of IMRAD structure of abstract whereas only 114(32.8%) were aware of manuscript writing guidelines for specific study design. More than half (61.5%) of the study subjects were not aware of different types of referencing styles, out of which 42(12.1%) were faculty members.

Table 2 [section B] Responses for attitude based questions on manuscript writing and research principles were gathered in which majority 334 (96%) of study subjects felt that research is important in dentistry moreover 290(83.3%) of students and 38(10.9%) of faculty members felt that dental student can plan and conduct research. Majority 316(90.8%) of the study subjects felt that research can be a good career option whereas 272(78.2%) students and 40(11.5%) faculty members felt that research outcome or article publication will help in their career.

Table 2 [section 3] Practice based questions on manuscript writing and research principles were included in the questionnaire, Thirty six percent of study subjects read journal regularly, in addition 238(68.4%) of study subject had never participated in workshop on research methodology out of which 224(64.4%) were students and 14(4%) faculty members. However 244(70.1%) are confident in presenting a research paper or poster in a conference. Only 78(22.4%) of students and 24(6.9%) faculty members had prepared a protocol for a research paper. 80(23%) of study subject felt that lack of mentorship were the biggest barrier for writing or publishing manuscript, beside that 66(19%), 60(17.2%), 38(11%), 38(10.9%), 34(9.8%) and 32(9.2%) felt that lack of interest, lack of UG research, cost, lack of workshop, lack of skill and lack of time were the other barrier for manuscript Writing respectively. Majority 148(42.5%) of the study subjects use google scholar to search literature review followed by PUBMED/COCHRANE/MEDLINE 110(31.6%), textbook 72(20.7%) and expert 18(5.2)google scholar to search literatu review followed by

TABLE: 2 Knowledge, attitude, and practices based questionnaire about manuscript writing and research principles among dental health professionals.

S.NO	QUESTION	OPTION	Student N(%)	Faculty N(%)	Total	P-Value
A	**KNOWLEDGE BASED QUESTIONS**					
1	DO YOU KNOW ABOUT ICMR OR ICMJE	ICMR	178(51.1)	30(8.6)	208(59.8)	0.135
		ICMJE	2(0.6)	0(0.0)	2(0.6)	
		BOTH	16(4.6)	6(1.7)	22(6.3)	
		NONE	110(31.6)	6(1.7)	116(33.3)	
2	ARE YOU AWARE OF RESEARCH HYPOTHESIS?	YES	166(47.7)	30(8.6)	196(56.3)	0.257
		NO	140(40.2)	12(3.4)	152(43.7)	
3	ARE YOU ARWARE OF IMRAD STRUCTURE OF ABSTRACT?	YES	62(17.8)	16(4.6)	78(22.4)	0.115
		NO	244(70.1)	26(7.5)	270(77.6)	
4	ARE YOU AWARE OF MANUSCRIPT WRITING GUIDELINES FOR SPECIFIC STUDY DESIGN?	YES	86(24.7)	28(8)	114(32.8)	0.000
		NO	218(62.6)	15(4.3)	232(66.7)	
5	ARE YOU AWARE OF DIFFERENT TYPES OF REFERENCING STYLES	YES	106(30.5)	28(8)	134(38.5)	0.000
		NO	200(57.5)	42(12.1)	214(61.5)	
B	**ATTITUDE BASED QUESTIONS**					
6	DO YOU FEEL RESEARCH IS IMPORTATNT IN DENTISTRY	YES	296 (85.1)	38 (10.9)	334(96)	0.632
		NO	8(2.3)	6(1.7)	14(4)	
7	DO YOU FEEL DENTAL STUDENT CAN PLAN AND	YES	290(83.3)	38(10.9)	328(94.3)	0.543
		NO	16(4.6)	4(1.1)	20(5.7)	

	CONDUCT RESEARCH					
8	DO YOU FEEL RESEARCH CAN BE A GOOD CAREER OPTION ?	YES	276(79.3)	40(11.5)	316(90.8)	0.227
		NO	30(8.6)	2(0.6)	32(9.2)	
9	DO YOU FEEL RESEARCH OUTCOME OR ARTICLE PUBLICATION WILL HELP IN YOUR CAREER?	YES	272(78.2)	40(11.5)	312(89.7)	0.590
		NO	34(9.8)	2(0.6)	36(10.3)	
C	**PRACTICE BASED QUESTIONS**					
10	DO YOU READ JOURNAL REGULARLY	YES	102(30.5)	24(6.9)	126(36.2)	0.003
		NO	200(57.5)	18(5.2)	222(63.8)	
11	HAVE YOU EVER PARTICIPATED IN WORKSHOP ON RESEARCH METHODOLOGY	YES	82(23.6)	28(8)	110(31.6)	0.000
		NO	224(64.4)	14(4)	238(68.4)	
14	MANUSCRIPT WRITING OR PUBLISHING	LACK OF SKILL	28(8)	6(1.7)	34(9.8)	0.348
		LACK OF WORKSHOP	36(10.3)	2(0.6)	38(10.9)	
		LACK OF UG RESEARCH	58(16.7)	2(0.6)	60(17.2)	
		LACK OF TIME	18(5.2)	14(4)	32(9.2)	
		COST	28(8.1)	10(2.9)	38(11)	
15	WHICH WEBSITE YOU PREFER TO SEARCH LITERATURE REVIEW	PUBMED/COCHRANE/MEDLINE	88(25.3)	22(6.3)	110(31.6)	0.007
		Google scholar	132(37.9)	16(4.6)	148(42.5)	
		Textbook	68(19.5)	4(1.1)	72(20.7)	
		Expert	18(5.2)	0(0)	18(	

DISCUSSION

Proficiency in research methods is essential for individuals employed in the medical and dental fields. It is ideal to learn about research throughout one's formative years, i.e during undergraduate or graduate school. [8] So far surveys have largely been given to medical professionals and there aren't enough comparable statistics among dental healthcare professionals. So, this study set out to evaluate the knowledge, attitudes, and practices of manuscript writing and research principles among dentist. [9]

Majority 334(96%) of the study subjects felt that research is important in dentistry which is in parallel with the results of Abdulrahman S,[10] considering that research serves as the cornerstone for upgrading healthcare, as well as many Indian dental programs and a number of undergraduate courses mandate research as part of their curriculum. More than half of the study population believed that dental students can plan and conduct research which is collateral with the results of Priya MM & Pandian KS [9] as research outcome or article publication will help in their career growth.

In our study over half of the study subjects were unaware of research hypothesis, ICMR or ICMJE and IMRAD format which is in contrast with the results of Mayyas F & Alzoubi K . [1] because, the current study's findings showed that more than half of the study participants had never created a research paper protocol, attended workshops on research methodology, or regularly read journals.

Sixty seven percentage of the present study subjects were not aware of manuscript writing guidelines for specific study design. There are different study designs which have their own reporting guidelines, such as CONSORT for randomized trials, STROBE for observational studies, PRISMA for systematic reviews and meta-analyses, and STARD for diagnostic accuracy studies. They assist authors in providing sufficient details about the study for editors, reviewers, readers, and other researchers assessing the medical literature to evaluate manuscript. Journals are encouraged to request that authors adhere to these standards.[5]

Examining the most recent and valuable information available online has become essential for scholars and researchers because, on a daily basis, thousands or even millions of scientific works are published as digital resources that are represented by the internet. Researchers cannot overlook this excellent

resource in order to locate relevant documents for their literature search that might not be available in any library. Search engines rank among the best resources for information retrieval due to the wide range of materials available online. In our study nearly half of the study subjects (42.5%) uses google scholar to search literature review followed by PUBMED/COCHRANE/MEDLINE which is in parallel with the study conducted by Samadzadeh GR.[11]

Despite the focus on advancing scientific research, obstacles exist that cause breach between theory and practice. In present study, the most common barrier stated was lack of mentorship and lack of time which is in parallel with the study conducted by Soe HHK et.al. [12] Hence, it has been accepted that supportive positive environment to conduct research study can bring successful researcher and have an impact on research output including publication.

Major strength of this study is that it explores an under- research yet essential aspects of academic development among dental health professionals in this territory- manuscript writing and research principles although single-centred study may affect the generalizability of the results.

CONCLUSION

In our study it was found that there were lack of knowledge and awareness regarding manuscript writing and research principles among dental health professionals at Dental Institute but the attitude was found to be positive. Hence, there should be conduction of professional workshops to enhance knowledge and in addition, adequate time should be allotted for the students apart from their regular curriculum to conduct and promote research work.

REFERENCES

1. Mayyas F, Alzoubi K. Awareness and knowledge of manuscript writing and research integrity: A cross sectional survey among graduate students. Heliyon. 2022 Nov 1;8(11):1-9
2. Patil A, Langade D. Knowledge, attitude,and practice of publication of manuscript in a scientific journal: A cross-sectional study among health-care practitioners. D Y Patil J Health Sci 2021;9:12-6.
3. Bajwa SJ, Sawhney C. Preparing manuscript: Scientific writing for publication. Indian J Anaesth. 2016 Sep;60(9):674-678.
4. Wenzel V, Dünser MV, Lindner KH. A step by step guide to writing a scientific manuscript. Internat. J. Qualitative Methods. 2016;18:1609406919862424.
5. Aga SS, Nissar S. Essential guide to manuscript writing for academic dummies: an editor's perspective. Biochemistry Research International. 2022;2022(1):1492058.
6. Liumbruno GM, Velati C, Pasqualetti P, Franchini M. How to write a scientific manuscript for publication. Blood Transfusion. 2013 Apr;11(2):217.
7. Villena F, Véliz C, García-Huidobro R, Aguayo S. Generative artificial intelligence in dentistry: Current approaches and future challenges. arXiv preprint arXiv:2407.17532. 2024 Jul 24.
8. "Knowledge, Attitude, Practice, And Barriers Of Undergraduate Dental Students Toward Scientific Research: A Web-Based Questionnaire Survey.". Int. J. Environ. Sci. 2025 Aug. 20 [cited 2025 Oct. 4];5099-106.
9. Priya MM & Pandian KS. A Survey of the Knowledge, Attitude and Practices in Research among Undergraduate Dental Students. Int. J. Pharm. Sci. Rev. Res. May-June 2017; 44(2):1-4.
10. Abdulrahman S, Aboalshamat K, Muthana M, Sait G, Bantan N, Hafiz S,

Mahrous R, Alsuhaqi A. Knowledge, attitude, practice, motives and barriers towards scientific research among dentists and dental students in Saudi Arabia. The Open Dentistry Journal. 2020 Dec 23;14(1).

11. Samadzadeh GR, Rigi T, Ganjali AR. Comparison of Four Search Engines and their efficacy With Emphasis on Literature Research in Addiction (Prevention and Treatment). Int J High Risk Behav Addict.2013; 1(4): 166-71.

12. Soe HH, Than NN, Lwin H, Htay MN, Phyu KL, Abas AL. Knowledge, attitudes, and barriers toward research: The perspectives of undergraduate medical and dental students. Journal of education and health promotion. 2018 Jan 1;7

Knowledge, Attitude and Practices of Post-graduate Students in Maharashtra, Regarding Smartphone Apps Used in Paediatric Dentistry - A Cross-sectional Study.

Abstract

Introduction: We are constantly 'in touch' with the world, and one of the ways that mobile phones have revolutionized this trend is by providing a platform for mobile apps. In Paediatric Dentistry, applications have been developed for both patients and dentists. They provide an opportunity for Paediatric Dentists to integrate technology into their clinical practices, to instill oral hygiene habits for Paediatric patients.

Aim: To assess knowledge, attitudes and practices of post-graduate students in Maharashtra, Regarding Smartphone Apps used in Pediatric Dentistry.

Materials and Methods: This cross-sectional questionnaire-based study was conducted by distributing questionnaires among postgraduate students studying Pediatric Dentistry in Maharashtra. The questionnaire consists of questions adapted from similar studies and includes closed-ended and single-select (Yes/No) questions. Data collected was compiled onto an MS Office Excel worksheet & was subjected to statistical analysis.

Results: In this study Total of 259 questionnaires were distributed, out of which 157 responses were obtained. 92% of students have heard about smartphone apps designed for Pediatric Dentistry, and 99% of them thought the apps would be useful in dental care. 98% of respondents were interested to learn more and would like to recommend fellow dentists about using smartphone apps in the future. Among the three PG batches, final year students had more knowledge about the apps in Paediatric Dentistry

Conclusion: The study concluded that there is a lack of knowledge regarding smartphone apps among post-graduate Pediatric dental students.

Keywords - Smartphone apps, Paediatric Dentistry, Artificial Intelligence.

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INTRODUCTION:

There has been an incredible growth in the use of apps over the recent years, and we often hear the words 'there's an app for that'. Mobile apps are software programs that run on smartphones and other mobile devices. Over 75 billion apps have been downloaded from the Apple App Store since its launch in 2008, and over 50 billion apps have been downloaded from Google Play (Underwood et al. 2015)[1]. Mobile health or mHealth refers to the use of mobile devices to facilitate data and information exchange between patients and health care providers. mHealth applications have become increasingly popular due to improved global cellular infrastructure

and the increased affordability of mobile devices. It is not just adults who own a device capable of running mobile apps, as reports suggest that 6-year-olds understand digital technology better than adults (Underwood et al. 2015).[1] Nowadays, children from all age groups play countless games on the phone, talking to their friends for long hours, or even browsing the internet. Apps have evolved over the years, and they exert in our daily life, even expanding into medical practice and science. Whether it is for the training of healthcare professionals, communication between patient and clinician, or patient self-use, apps are found to simplify and improve patient care.[1]

Smartphone applications are much more convenient and easily available, while needing no additional hardware such as virtual reality gear. Smartphone dentist games available online are approved by a panel of experienced Pedodontics for clinical usage and demonstrate the use of common dental equipment, in the form of animated pictures with visual and sound effects. Unlike movies and live modelling, in which the child is a passive learner, playing games can allow an interactive reward-dependent and usually appealing experience for the child and might act as a more attractive option of pretreatment exposure and modelling to the children of the third millennium.[1] According to different surveys, it was concluded that there around 151 applications related to Paediatric Dentistry available for Android phones and 168 for IOS devices. These applications include apps that aid in Practice Management/ Aiding Diagnosis, apps giving access to Publications/Journals/News Dental Emergency, apps aiding to formulate Paediatric Dental Drugs Management Apple App Store Applications for Paediatric, Apps for Patients and Their Families, Games, General Information for Families, Brush Timers and Simulations for Children and Dental Emergency.[1] Another thrilling option is the gamification of such apps. Gamification is the "use of video game elements in non-gaming systems". Gamification features, including badges, levels, leaderboards, etc. Gamification is the use of features to increase target behaviour and engagement, enabling users to perform tasks more effectively and enjoyably.

This study aims to assess knowledge, attitudes and practices of post-graduate students studying Pediatric Dentistry in Maharashtra, regarding Smartphone Apps used in Pediatric Dentistry.

MATERIALS AND METHODS

A cross-sectional questionnaire-based study was conducted in the Department of Paediatric and Preventive Dentistry. Ethical approval was obtained from the Research and Ethics Committee, Yogita Dental College and Hospital, Khed, Ratnagiri.

Inclusion criteria:

• Postgraduate Students in Maharashtra studying Paediatric Dentistry

Exclusion criteria:

• Participants who gave an incomplete Questionnaire.

• Those who did not consent to the study and those who did not respond within the time frame of fifteen days.

Sample Size Calculation:

Sample size was determined using the estimates from the KADAM KS, GOKHALE NS, HUGAR SM, JOSHI RS, KOHLI N, DIALANI PK. Evaluation of Knowledge, Attitude, and Practices about Paediatric Dental Apps among Paediatric Dentists in India: A Questionnaire-based, Cross-sectional Study. animation. 2022 Mar 1;4(364):98-38.[16] & using a single proportion formula. The sample size was estimated to 114 respondents to generalize the results to a larger target population.

A questionnaire was formed on the basis of questions that need to be asked to obtain the knowledge, attitude, and practice components. The questionnaire consists of questions adapted from similar studies and includes closed-ended and single-select (Yes/No) questions. The participants were instructed regarding the filling of the questionnaire. The time given to fill out the questionnaire was fifteen days. The e-questionnaire was sent through Google Forms to the respective WhatsApp numbers of students. A total 259 questionnaires were distributed out of which 157 responses were obtained.

STATISTICAL ANALYSIS

Data was collected and compiled onto an MS Office Excel worksheet & was subjected to statistical analysis using an appropriate package like SPSS software. Descriptive statistics like frequency (n) & percentage (%) of categorical data, mean, & Standard deviation of numerical data in each group were depicted. Comparison of the frequency of responses with independent variables was done using the chi-square test.

RESULTS:

92% of students have heard about smartphone apps designed for paediatric dentistry, and 99% of them thought the apps would be useful in dental care. 59% of the respondents have never installed any apps related to paediatric dentistry, but among the once who installed the maximum were from the final year of the program. Maximum number of respondents, i.e, more than 95%, thought apps can be useful for giving oral hygiene instructions, easy consultation, supervising the diet, and calculating the drug dosage faster. Also, they agreed that the simulation games can be useful in reducing pretreatment anxiety before the 1st dental visit. About 99% of respondents thought brushing games and timers can encourage good brushing habits, especially when gamification was added to make it more fun. 98% of the respondents think children are capable of operating smartphones, and they can be easily accessed by patients and parents. 86% of respondents were aware of tele-dentistry. On asking about the knowledge about apps available for orthodontic treatment, controlling oral habits, apps for autistic children, and expectant mothers, it was found that awareness was comparatively lesser, i.e, less than 50%. 95% of the respondents think that the apps can improve access to oral health care services for Paediatric patients in rural India. 98% of

respondents were interested to learn more and would also suggest or recommend fellow dentists about using smartphone apps in the future. Among the three PG batches, final year students had more knowledge about the apps in Paediatric Dentistry.

Questions	Year of education	No	Yes	Total	Chi-Square value	P-value of the Chi-Square test
Have you ever heard of smartphone applications designed for Pediatric Dentistry?	1st year	9	43	52	10.430	0.005**
	2nd Year	1	52	53		
	3rd Year	2	50	52		
	Total	12	145	157		
Are you aware about different apps available for dental students and practitioners?	1st year	37	15	52	63.670	0.000**
	2nd Year	7	46	53		
	3rd Year	3	49	52		
	Total	47	110	157		
Have you ever installed any apps related to Pediatric Dentistry?	1st year	51	1	52	70.547	0.000**
	2nd Year	33	20	53		
	3rd Year	9	43	52		
	Total	93	64	157		
Have you ever used an app for diagnostic purposes?	1st year	50	2	52	57.800	0.000**
	2nd Year	32	21	53		
	3rd Year	12	40	52		
	Total	94	63	157		
Can a smartphone app be a useful tool for giving oral hygiene instructions to Pediatric patients?	1st year	2	50	52	4.068	0.131#
	2nd Year	4	49	53		
	3rd Year	0	52	52		
	Total	6	151	157		
Do you think you can supervise the diet of your patients through smartphone apps?	1st year	3	49	52	1.790	0.409#
	2nd Year	4	49	53		
	3rd Year	1	51	52		
	Total	8	149	157		
Do you think an app can be a faster way to calculate drug dosages for writing prescriptions?	1st year	1	51	52	1.994	0.369#
	2nd Year	2	51	53		
	3rd Year	0	52	52		
	Total	3	154	157		
Do you know about the smartphone apps available for cephalometric analysis, model analysis and CMV stage guide for orthodontic treatment?	1st year	47	5	52	65.316	0.000**
	2nd Year	30	23	53		
	3rd Year	6	46	52		
	Total	83	74	157		
	1st year	37	15		19.107	0.000**
Name the app that is used for dental trauma education given by International Association of Dental Traumatology (IADT)	2nd Year	19	34			
	3rd Year	17	35			
	Total	73	84			
Are you aware about Tele dentistry?	1st year	20	32	52	38.572	0.000**
	2nd Year	1	52	53		
	3rd Year	1	51	52		
	Total	22	135	157		
Can smartphone apps provide a platform for easy consultation with Pediatric Dentists?	1st year	2	50	52	2.072	0.355#
	2nd Year	0	53	53		
	3rd Year	1	51	52		
	Total	3	154	157		
Do you think Children are capable of operating smartphones?	1st year	0	52	52	1.004	0.605#
	2nd Year	1	52	53		
	3rd Year	1	51	52		
	Total	2	155	157		
Do you think smartphone apps are easy to access for patients and parents?	1st year	0	52	52	4.091	0.129#
	2nd Year	0	53	53		
	3rd Year	2	50	52		
	Total	2	155	157		
Do you think Simulation Games can be useful in reducing pre-treatment anxiety before the first dental visit of a child?	1st year	1	51	52	0.000	1.000#
	2nd Year	1	52	53		
	3rd Year	1	51	52		
	Total	3	154	157		
Do you think brushing games and timers can encourage good brushing habits in children?	1st year	0	52	52	2.032	0.362#
	2nd Year	0	53	53		
	3rd Year	1	51	52		
	Total	1	156	157		
Do you think Gamification (including the rewards/coins etc) of Pediatric dental apps can be useful in making dental appointments more fun and interesting for children?	1st year	3	49	52	3.641	0.162#
	2nd Year	0	53	53		
	3rd Year	1	51	52		
	Total	4	153	157		
Do you know about smartphone apps available for controlling deleterious oral habits?	1st year	46	6	52	59.589	0.000**
	2nd Year	31	22	53		
	3rd Year	7	45	52		
	Total	84	73	157		
Are you aware about smartphone apps designed for Autistic Children?	1st year	51	1	52	66.396	0.000**
	2nd Year	30	23	53		
	3rd Year	10	42	52		
	Total	91	66	157		
Do you know about different apps available for expectant mothers regarding oral health care?	1st year	48	4	52	53.613	0.000**
	2nd Year	30	23	53		
	3rd Year	11	41	52		
	Total	89	68	157		
Can Smartphone apps improve access to oral healthcare services for Pediatric patients in rural India?	1st year	3	49	52	3.960	0.138#
	2nd Year	0	53	53		
	3rd Year	4	48	52		
	Total	7	150	157		
In the future, are you interested to learn more and use smartphone apps in your practice?	1st year	0	52	52	1.004	0.605#
	2nd Year	1	52	53		
	3rd Year	1	51	52		
	Total	2	155	157		
Will you suggest/recommend fellow dentists/dental students to use smartphone apps in their day-to-day practice?	1st year	0	52	52	1.994	0.369#
	2nd Year	2	51	53		
	3rd Year	1	51	52		
	Total	3	154	157		

Chi-Square Tests; # indicates statistically non significant p>0.05.

Chi-Square Tests; **indicates highly statistically significant p<0.01.

DISCUSSION

In the past decade, the way technology has taken leaps and bounds is unprecedented. Dentistry was no exception to the advent of mobile applications. These applications eliminate time constraints by providing health care services to people at any time of the day or night. The field of Paediatric Dentistry is also influenced by these developments, and the number of related applications is increasing daily. Children love the variety of exciting videos that supply them with a plethora of information, and are hooked on to them from a very young age. Smartphone applications have limitless potential when used as a learning

tool. They can create awareness, spread knowledge, and can provide guidance in adopting new lifestyle practices.

Since smartphones have become very common and technologically very advanced, they can be equipped with proper simulation games. They can act as a new, convenient, and economical way to reduce dental anxiety in children. Shaha. H et al. (2017)[2] evaluated the reduction in anxiety parameters and found that it was almost double in the smartphone application group as compared to the conventional behaviour management group, using smartphone applications "Kid Dentist" and "Monster Dentist". Zink, A.G. et al. (2018)[3] developed and evaluated an application "Autistic Child Going to the Dentist", which facilitates patient-dentist communication among individuals with autism spectrum disorder (ASD), and compared it with the Picture Exchange Communication System (PECS). It was found to be more effective than the Picture Exchange Communication System for dentist-patient communication during the first dental visit, for preventive care, and for clinical examination of children and adolescents with ASD.

Apps are fairly innovative tools for tooth-brushing motivation and very little research has been published on the content and the effectiveness of these apps in terms of behaviour change (Underwood et al. 2015). Mobile devices' characteristics and features, such as ubiquity, reduced size and weight, ease of use, reduced cost, touchscreens, integrated speakers, and input for headphones, allow the implementation of dental anxiety behavioural techniques, enabling interventions in different contexts: during dental visits, in the waiting room, during the pretreatment stage, etc. The advent of smartphone apps for tooth brushing has added a new arena to oral hygiene awareness in terms of motivation, training and gamification for children.

Loureiro JM et al. (2021)[12] searched the existing Traumatic Dental Injuries (TDI) applications (Apps) to critically describe the characteristics and main information found in them regarding TDI. Most were free (92.3%), for patients (38.4%), and had a free age classification (90.9%). Most of the Apps were for permanent teeth (61.5%) and had explanations about dental management for TDI emergencies (92.3%) and multiple TDIs (61.5%). Most Apps addressed the importance of monitoring TDIs (76.9%) and contained illustrative images (76.9%). However, many did not report the TDI classification (46.1%), and 38.5% reported TDI prevention. The authors concluded that information on dental trauma management according to dental injury, inclusion of images, target audience, type of TDI, and their prevention varied in the available Apps. Duruk G, Gümüşboğa ZŞ. (2022)[13] assessed the effectiveness of the ToothSOS App launched by the IADT on the level of knowledge about emergency management of TDIs (Traumatic Dental Injuries) among people who are not dental professionals. The ToothSOS App was effective in increasing the knowledge level of individuals about the emergency management of TDIs.

Goh CE et al. (2024)[14] presented the development and key features of a dental-specific mobile app for diet monitoring and dietary behaviour change to prevent caries, and pilot data from initial user evaluation. The mobile app incorporating a novel photo recognition algorithm and a localized database of 208,718 images for food item identification was developed. Pilot user evaluations indicated good app quality, suggesting its potential as a useful clinical tool for dentists and empowering patients for self-monitoring and behavioural

management. Kamath S, Jawdekar A M (2023)[17] compared innovative "app-based" and handwritten prescriptions in dental settings. An indigenously developed app "PREscribing children made EASY (PREASY)" was used in this study. The conventional handwritten and an Android app PREASY-based prescriptions were compared in terms of the time taken, precision of writing, and satisfaction of the dentists. Qualitative feedback regarding the PREASY app was obtained in Google Forms and concluded that the PREASY app seems to be a promising mHealth app and could play an instrumental role in fostering the standardization of drug prescriptions in pediatric dental patients. Manfredini et al. (2016)[18] studied the effectiveness of BruxApp to assess awake bruxism. Cognitive-behavioral approaches are a fundamental part of management strategies, and it is plausible that an app that instructs patients on the consequences of bruxism and has a biofeedback function may have an interesting clinical potential by maximizing patients' self-awareness. Such an approach may offer several advantages both in clinical and research settings and may help overcome current difficulties in studying and managing such phenomena. Panchal V, Gurunathan D, Shanmugaavel AK (2017)[19] assessed the dietary and oral hygiene patterns, before and after the usage of the "Cariometer" app. Hence, there was a significant improvement in the dietary patterns and oral hygiene habits after the use of app.

Kadam S.K et al. (2022)[16] carried out a similar KAP study where they assessed knowledge, attitude and practices about paediatric dental apps among paediatric dentists in India and concluded that there is a lack of awareness among paediatric dentists that anxiety-reducing dental apps could be used as an adjunct with conventional behaviour management techniques among paediatric dentists in India. Further educational seminars and/or workshops, if necessary, could be conducted for the paediatric dentists regarding awareness of dental apps newer apps could be developed in different regional languages too for apps to be more effective. There are numerous smartphone apps available today. These apps help dentists in several ways and have been a new modality in providing dental treatment. These apps have proved to be useful, but keeping the ill effects in mind, the authenticity of the apps, recommended to the patients and parents also needs to be evaluated. Nevertheless, in today's techno-friendly world, where children spend hours on smartphones, playing such useful games and apps rather than the normal games might help them in fostering good oral habits and can be reinforced for life lifetime.

CONCLUSION

The findings of this study highlight a general lack of knowledge regarding smartphone applications among postgraduate students in Paediatric Dentistry. Notably, final-year students demonstrated a higher level of awareness and understanding compared to their first- and second-year counterparts. Despite this knowledge gap, the overall attitude of postgraduate students towards the use of smartphone apps was found to be positive. These results underscore the need for increased awareness and educational initiatives, such as seminars and workshops, to enhance students' familiarity with relevant applications.

REFERENCES

1) Dambare A, App-tastic Pediatric Dentistry- The Ultimate guide to Smartphone Applications in Paediatric Dental Care. India: Lambert: 2024.

2) Shah HA, Nanjunda Swamy KV, Kulkarni S, Choubey S. Evaluation of dental anxiety and hemodynamic changes (Sympatho-Adrenal Response) during various dental procedures using smartphone applications v/s traditional behaviour management techniques in pediatric patients. Int J Appl Res. 2017;3(5):429-33.

3) Zink AG, Molina EC, Diniz MB, Santos MT, Guaré RO. Communication application for use during the first dental visit for children and adolescents with autism spectrum disorders. Pediatric dentistry. 2018 Jan 1;40(1):18-22.

4) Patil VH, Vaid K, Gokhale NS, Shah P, Mundada M, Hugar SM. Evaluation of effectiveness of dental apps in management of child behaviour: A pilot study. Int J Pedod Rehabil. 2017 Jan 1;2(1):14-8.

5) Meshki R, Basir L, Alidadi F, Behbudi A, Rakhshan V. Effects of pretreatment exposure to dental practice using a smartphone dental simulation game on children's pain and anxiety: a preliminary double-blind randomized clinical trial. Journal of Dentistry (Tehran, Iran). 2018 Jul;15(4):250.

6) Radhakrishna S, Srinivasan I, Setty JV, DR MK, Melwani A, Hegde KM. Comparison of three behavior modification techniques for management of anxious children aged 4–8 years. Journal of dental anesthesia and pain medicine. 2019 Feb 28;19(1):29.

7) Soler C, Zacarías A, Lucero A. Molarcropolis: a mobile persuasive game to raise oral health and dental hygiene awareness. InProceedings of the international conference on advances in computer entertainment technology 2009 Oct 29 (pp. 388-391).

8) Shao K, Huang J, Song H, Li R, Wu J. DAYA: a system for monitoring and enhancing children's oral hygiene. InCHI'14 Extended Abstracts on Human Factors in Computing Systems 2014 Apr 26 (pp. 251-256).

9) Fijačko N, Gosak L, Cilar L, Novšak A, Creber RM, Skok P, Štiglic G. The effects of gamification and oral self-care on oral hygiene in children: systematic search in app stores and evaluation of apps. JMIR mHealth and uHealth. 2020 Jul 8;8(7):e16365.

10) Djemal S, Singh P. Smartphones and dental trauma: the current availability of apps for managing traumatic dental injuries. Dental traumatology. 2016 Feb;32(1):52-7.

11) Machado JP, Lam XT, Chen JW. Use of a clinical decision support tool for the management of traumatic dental injuries in the primary dentition by novice and expert clinicians. Dental Traumatology. 2018 Apr;34(2):120-8.

12) Loureiro JM, Jural LA, Soares TR, Risso PA, Fonseca-Gonçalves A, Magno MB, Maia LC. Critical appraisal of the information

available on traumatic dental injuries found in applications. Dental traumatology. 2022 Feb;38(1):77-87.

13) Duruk G, Gümüşboğa ZŞ. Effectiveness of the ToothSOS app as a training tool for the emergency management of traumatic dental injuries among non-dentists. Dental Traumatology. 2022 Jun;38(3):229-37.

14) Goh CE, Zheng K, Chua WY, Nguyen T, Liu C, Koh CK, Lee GK, Tay CM, Ooi BC, Wong ML. Development of a dental diet-tracking mobile app for improved caries-related dietary behaviours: Key features and pilot evaluation of quality. Digital health. 2024 Jan;10:20552076241228433.

15) Alqarni AA, Alfaifi HM, Aseeri NA, Gadah T, Togoo RA. Efficacy of a self-designed mobile application to improve child dental health knowledge among parents. Journal of International Society of Preventive and Community Dentistry. 2018 Sep 1;8(5):424-30.

16) Kadam Ks, Gokhale Ns, Hugar Sm, Joshi Rs, Kohli N, Dialani Pk. Evaluation of Knowledge, Attitude, and Practices about Paediatric Dental Apps among Paediatric Dentists in India: A Questionnaire-based, Cross-sectional Study. animation. 2022 Mar 1;4(364):98-38.

17) Kamath S, Jawdekar AM. A comparison of innovative app-based prescriptions with conventional prescriptions for children by general dentists: a mixed methods study. Cureus. 2023 Jan 10;15(1).

18) Manfredini D, Bracci A, Djukic G. BruxApp: the ecological momentary assessment of awake bruxism. Minerva stomatologica. 2016 Aug;65(4):252-5.

19) Panchal V, Gurunathan D. Smartphone application as an aid in determination of caries risk and prevention: A pilot study. European journal of dentistry. 2017 Oct;11(04):469-74.

Nutrition and Oral Health - KAP Survey among Dental Students at Darbhanga Bihar

Abstract

Background: Nutrition and oral health are closely interconnected, as diet plays a critical role in the prevention and progression of dental diseases. Dental students, as future oral health professionals, should possess sound knowledge and positive attitudes regarding diet–oral health relationships. However, previous studies indicate a gap between theoretical understanding and practical application of nutrition-based counselling. This study aimed to assess the knowledge, attitude, and practices (KAP) regarding diet and nutrition in relation to oral health among dental students.

Materials and Methods: A descriptive cross-sectional survey was conducted among dental students of Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India. Data were collected using a pre-validated, structured online questionnaire based on the WHO KAP framework. The questionnaire comprised four sections: demographic details, knowledge, attitude, and practices. Data were analysed using SPSS version 25. Descriptive statistics and Chi-square tests were applied, with a significance level set at $p < 0.05$.

Results: Among 117 participants (82.1% females; 41.9% final-year students), 94% identified carbohydrates as cariogenic and 82.1% recognised sucrose as the most cariogenic sugar. Although 93.2% agreed that dietary counselling should form part of dental education, only 53.8% reported having received formal training. Nearly half (47%) admitted to occasional sugary-snack consumption, indicating a gap between knowledge and behaviour.

Conclusion: Dental students exhibited high theoretical knowledge and positive attitudes toward diet and oral health, but inconsistent practices. Incorporating structured, skill-based nutrition education and interprofessional collaboration within dental curricula is essential to bridge the knowledge–practice gap and promote preventive oral health.

Keywords: Oral health, Nutrition, Diet ,Dental Students

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INTRODUCTION

Nutrition and oral health are closely interrelated and together form an essential component of overall health. The oral cavity is the first site of interaction between diet and the body, and its health depends largely on adequate nutrient intake. Conversely, poor oral health may affect chewing, swallowing, and speech, which in turn can lead to altered dietary habits and nutritional deficiencies[1]. The World Health Organization recognizes diet as a modifiable risk factor for both oral and general diseases[2]. Among oral conditions, dental caries and periodontal diseases are the most prevalent worldwide and are significantly influenced by diet—particularly the frequency and amount of fermentable carbohydrate and free sugar consumption[3]. High exposure to sticky, sugary, or acidic foods promotes enamel demineralization and microbial colonization[4]. In contrast, micronutrients such as vitamins C, B_{12}, calcium, and folic acid play crucial roles in maintaining oral tissue integrity and wound healing[5–6].

Sucrose, in particular, has been established as the most cariogenic sugar due to its ability to enhance bacterial adherence and acid production[7]. An imbalance between cariogenic dietary factors and protective nutrients, such as fibrous foods and dairy products, can disrupt the oral microbiome and promote disease[8–9]. Furthermore, deficiencies in essential nutrients have been associated with oral mucosal atrophy, gingival inflammation, and delayed tissue repair[10]. Despite this established relationship, the importance of diet in oral health is often underemphasized in both clinical practice and dental education[11].

Dental professionals are ideally positioned to offer dietary counseling that can prevent and manage oral diseases. However, multiple studies have revealed a consistent gap between theoretical understanding and practical application of dietary counseling among dental students and practitioners[12–14]. Knowledge, Attitude, and Practice (KAP) surveys across various countries have shown that while students recognize the importance of nutrition, only a small proportion incorporate evidence-based dietary guidance in clinical settings[15–17]. This may be attributed to limited curricular exposure, lack of structured training, and minimal interprofessional collaboration with dietitians[18–19]. Consequently, the ability of dental graduates to integrate preventive nutrition-based care remains restricted.

Although numerous international studies have explored diet and oral health awareness among medical or general student populations, limited research has been conducted among dental students within Indian institutions[20–22]. Given that dental students represent future oral health educators and clinicians, it is essential to evaluate their current knowledge, attitude, and self-reported practices regarding diet and nutrition. Identifying existing educational deficiencies will help inform curriculum development, enhance preventive care training, and strengthen the capacity of dental professionals to deliver dietary counseling in clinical practice.

Hence, the present study was undertaken to assess the knowledge, attitude, and practices regarding diet and nutrition in relation to oral health among dental students

of Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India.

MATERIALS AND METHODS

Study Design and Setting

This descriptive cross-sectional study was conducted among dental students of Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India, over two months (May–June 2025). The institution offers undergraduate and postgraduate dental education and provides a suitable academic environment for evaluating nutrition-related oral-health awareness. The study was approved by the Institutional Ethics Committee (IEC/MMDC/2025/07) before commencement.

Participants

Total number of students (1st year to final year) enrolled during the study period were invited to participate. Inclusion criteria included students willing to provide informed consent and complete the online questionnaire in full. Exclusion criteria comprised students unwilling to participate, those submitting incomplete or duplicate responses, and those absent during data collection. A nonprobability convenience sampling technique was adopted to maximize participation, yielding 117 valid responses (response rate = 73.1%).

Data Collection Tool

Data were gathered using a structured, self-administered online questionnaire developed through Google Forms. The instrument was designed after reviewing previous studies and the World Health Organization Knowledge, Attitude and Practice (KAP) framework for diet and oral health[1–3]. Content validity was established by three experts in Public Health Dentistry, and a pilot test on ten students (excluded from final analysis) confirmed clarity and reliability. Necessary linguistic revisions were incorporated before distribution.

The final questionnaire comprised four sections among which one of the option was most appropriate.

Section A: Demographic details (age, gender, year of study, residence).

Section B: Knowledge—eight multiple-choice questions related to diet, nutrition, and oral health.

Section C: Attitude—eight Likert-scale items assessing perception and motivation toward dietary counselling.

Section D: Practice—four questions on self-reported dietary habits and patient counselling behaviours.

Bias Control

Several strategies were implemented to minimise bias. Participation was voluntary and anonymous to reduce social-desirability bias. The online mode prevented peer or faculty influence. Standardised instructions were provided, and no identifying data were collected. Pilot testing ensured internal consistency and eliminated ambiguous items.

Statistical Analysis

All responses were exported to Microsoft Excel and analysed using IBM SPSS Statistics version 25.0. Descriptive statistics (frequency, percentage, mean ± standard deviation) summarised demographic and KAP data. The Chi-square (χ^2) test examined associations between demographic factors and KAP scores. A p-value < 0.05

was considered statistically significant. Internal reliability of the questionnaire, assessed using Cronbach's α, was 0.82, indicating good internal consistency[7–8].

RESULTS

A total of 160 questionnaires were initially distributed to the study participants. A total of 117 completed questionnaires were returned and included in the final analysis, yielding a response rate of **73.1%** (117/160).Among the study participants (N=117), a majority were female (96; 82.1%), while male students constituted 21 (17.9%).

The majority of respondents (41.9%) were final-year students, followed by third-year (20.5%), second-year (17.1%), and first-year students (15.4%). A small proportion (5.1%) were postgraduate students. Most participants (86.3%) resided in urban areas, while 13.7% were from rural backgrounds.

Table 1. Demographic Profile of Study Participants (N=117)

Characteristic	Category	N (Count)	% (Percentage)
Gender	Male	21	17.9
	Female	96	82.1
Academic Year	1st Year	8	6.8
	2nd Year	20	17.1
	3rd Year	24	20.5
	Final Year	49	41.9
	Postgraduate	16	13.7
Area of Residence	Urban	101	86.3
	Semi-urban	10	8.5
	Rural	6	5.1

Knowledge-Based Responses

Table 2a summarizes participants' responses regarding diet and oral health knowledge. The majority (94%) identified carbohydrates as the most cariogenic nutrient, and 82.1% correctly recognized sucrose as the most cariogenic sugar. Nearly all respondents (96.6%) were aware that fluoride helps prevent dental caries, while 90.6% knew that frequent snacking increases caries risk. However, only 52.1% were aware of the WHO recommendation limiting free sugar intake to <10% of total daily energy, indicating a moderate knowledge gap.

Table 2a. Summary of Key Knowledge Responses (N=117)

Question	Most Common Correct Response	N (Count)	% (Percentage)
Nutrient most linked with dental caries	Carbohydrate	110	94.0
Sugar with the highest cariogenic potential	Sucrose	96	82.1
Effect of frequent sugary snacks	Increases risk of caries	112	95.7
Mineral essential to prevent caries	Fluoride	113	96.6
Most tooth-friendly beverage	Water	104	88.9
Gap Area: WHO recommendation on free sugars (<10% of daily energy)	<10\%	61	52.1

Attitude-Based Responses

Attitudes toward diet and oral health were generally positive (Table 2b). Almost all respondents (93.2%) agreed that balanced nutrition is crucial for maintaining oral health, and 92.3% believed that dietary counselling should form an integral part of dental practice. In addition, 88.9% reported that dentists have an ethical responsibility to provide nutritional advice to patients. However, 41% felt that dietary counselling is often overlooked in dental clinics due to time constraints

Table 2b. Summary of Attitude Responses (Percentage of 'Yes' Responses)

Question	Yes (%)	No (%)	Maybe (%)
Balanced diet plays a crucial role in oral health	98.3	0.9	0.9
Dental students should receive proper training	93.2	1.8	5.0
Question	Yes (%)	No (%)	Maybe (%)
in dietary counseling			
Limiting sugar intake is important for preventing dental diseases	92.3	1.8	5.9
Promoting awareness is the responsibility of dental professionals	94.0	2.7	2.7
Processed/sugary foods should be discouraged in all age groups	84.6	8.3	7.3

Practice-Based Responses

Despite strong knowledge and attitudes, practices were inconsistent (Table 2c). Nearly half (47%) reported occasional consumption of sugary snacks, and 63.2% consumed sweetened beverages occasionally. Only 53.8% had received formal instruction on diet and oral health during their dental education. Regular counselling of patients about diet was reported by 44.4% of respondents, suggesting an evident knowledge– practice gap.

Table 2c. Summary of Key Practice Responses (N=117)

Question	Most Common Response	N (Count)	% (Percentage)
How often do you consume sugary snacks/drinks?	Occasionally	55	47.0
Do you consume carbonated or sweetened beverages regularly?	Occasionally	74	63.2
Crucial Gap: Have you received formal instruction on diet and oral health?	Yes	63	53.8
Do you provide dietrelated advice to family/friends?	Sometimes	61	52.1
Do you check sugar content on food labels before buying?	Sometimes	53	45.3
Do you avoid brushing immediately after acidic drinks/foods?	Yes	66	56.4

Associations Between Variables

Chi-square analysis revealed no statistically significant association between gender and overall knowledge scores ($p = 0.21$). However, a significant relationship was observed between year of study and knowledge levels ($p = 0.02$), with final-year and postgraduate students scoring higher than undergraduates. No significant associations were found between residential background (urban vs. rural) and either attitude ($p = 0.34$) or practice ($p = 0.28$) scores.

These findings demonstrate that while theoretical awareness among dental students is satisfactory, translation into effective dietary practices and patient counselling remains suboptimal.

Overall, participants exhibited high knowledge and positive attitudes toward diet–oral health relationships but inconsistent dietary and counselling practices. These findings highlight the importance of reinforcing nutrition education within the dental curriculum to bridge the gap between theoretical knowledge and practical implementation.

DISCUSSION

The present study assessed the knowledge, attitude, and practices (KAP) related to diet and nutrition in relation to oral health among dental students of Mithila Minority Dental College and Hospital, Darbhanga. The findings demonstrated that participants possessed good theoretical knowledge and positive attitudes toward the importance of diet in oral health; however, their selfreported dietary habits and counseling practices were inconsistent. This observation highlights the well-documented gap between theoretical knowledge and its clinical application among dental students and professionals[1–3].

A high proportion of respondents (94%) correctly identified carbohydrates as cariogenic and 82.1% recognized sucrose as the most cariogenic sugar. These findings are consistent with previous research by Moynihan and Petersen[4] and Sheiham and James[5], who emphasized that frequent consumption of free sugars is the most important dietary factor contributing to dental caries. Likewise, 96.6% of students were aware of the caries-preventive role of fluoride, aligning with studies from Saudi Arabia and Egypt[6–7]. However, only 52.1% were aware of the WHO recommendation that free sugars should constitute less than 10% of total daily energy intake[2], indicating partial awareness of international dietary guidelines.

The positive attitude observed in this study reflects similar findings by Al-Wesabi et al.[8] and Chalmuri et al.[9], who reported that dental students recognize the significance of diet in oral health and endorse the inclusion of nutrition counseling in dental practice. More than 90% of the present participants agreed that balanced nutrition is essential for oral health and that dietary counseling should be part of dental care. This suggests that students conceptually understand the role of nutrition in preventive dentistry. However, despite this awareness, only about half of the participants had received formal instruction on diet and oral health, and less than half reported regularly counseling patients, suggesting inadequate translation of knowledge into action.

The limited integration of nutrition education into dental curricula may contribute to this gap. Similar observations were made by da Costa et al.[10], who noted that despite adequate knowledge, the absence of applied nutrition modules and clinical exposure prevents dental students from developing counseling confidence. Studies from India and abroad consistently report that dental education primarily emphasizes treatment rather than prevention, resulting in low motivation to incorporate dietary advice into patient care[11–13]. Moreover, the lack of collaboration between dental faculties and nutrition experts further restricts the multidisciplinary understanding required for effective diet counseling[14].

Behavioral factors may also influence this discrepancy. Nearly half of the respondents admitted to occasional sugary-snack consumption, reflecting a disconnect between personal and professional health behavior. This aligns with studies by Abdullah et al.[15] and Thomas et al.[16], which emphasized that personal health practices strongly influence a clinician's motivation and credibility in promoting healthy lifestyles among patients. Therefore, improving both personal and professional nutrition literacy is essential for developing well-rounded preventive practitioners.

In the present study, the year of study showed a statistically significant association with knowledge levels ($p = 0.02$), suggesting that knowledge increases with academic advancement. This is in agreement with findings by Al-Madi et al.[17] and El Tantawi et al.[18], who reported that senior dental students display greater awareness due to cumulative theoretical exposure. However, this study also revealed that clinical and behavioral competence does not necessarily improve with academic progression, reaffirming that theoretical instruction alone is insufficient to induce long-term behavioral change.

Strengths, Limitations, and Implications

A notable strength of this study is its complete institutional coverage, representing responses from the entire student population, thereby ensuring internal validity. The use of a pre-validated questionnaire based on the WHO KAP framework further enhances methodological reliability. However, as a single-institution cross-sectional study, its findings may not be generalizable to all dental students in India. Moreover, the reliance on self-reported data may have introduced recall and social-desirability bias, as participants might have overstated positive behaviors. Despite these limitations, the study provides valuable insight into the current status of nutrition-related awareness among dental students and underscores the urgent need for structured educational interventions.

The findings have several implications for dental education and practice. Curriculum planners should consider integrating nutrition education modules across both preclinical and clinical phases.

These modules should emphasize not only theoretical aspects but also skill-based learning, including dietary assessment, communication techniques, and patient-centered counseling. Collaborations with nutritionists and dietitians could further strengthen interprofessional education and provide dental students with hands-on exposure to dietary counseling in clinical settings. Periodic KAP assessments should be institutionalized to monitor improvements over time.

CONCLUSION

The present study revealed that dental students possess commendable knowledge and positive attitudes regarding the relationship between diet, nutrition, and oral health; however, their selfreported dietary practices and patient counselling behaviours remain inconsistent. This disparity underscores the persistent gap between theoretical understanding and clinical application. Integrating structured, skill-based nutrition education and interprofessional collaboration within dental curricula can enhance students' competence in delivering dietary counselling as part of comprehensive oral healthcare. Encouraging reflective learning and self-monitoring of personal dietary habits may further strengthen professional credibility and health promotion capacity. Future multi-institutional studies with larger and more diverse samples are recommended to validate these findings and establish standardized frameworks for incorporating nutrition training into dental education across India.

REFERENCES (Vancouver Style)

1. Touger-Decker R, Mobley CC. Position of the American Dietetic Association: oral health and nutrition. J Am Diet Assoc. 2007;107(8):1418-1428.

2. World Health Organization. Sugars and dental caries. WHO Technical Information Note. Geneva: WHO; 2017.

3. Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. Public Health Nutr. 2004;7(1A):201-226.

4. Sheiham A, James WPT. Diet and dental caries: the pivotal role of free sugars re-emphasized. J Dent Res. 2015;94(10):1341-1347.

5. Najeeb S, Zafar MS, Khurshid Z, Zohaib S. Role of nutrition in oral and systemic health. Gen Dent. 2016;64(3):20-24.

6. Khan RS, Khan MA. Nutritional deficiencies and their oral manifestations. J Med Sci. 2019;27(2):159163.

7. Marsh PD. Are dental diseases examples of ecological catastrophes? Microbiology. 2003;149(2):279294.

8. Costin G, Kuczynski E. Nutritional disorders and oral health implications in adolescents. Adolesc Med Clin. 2006;17(3):605-617.

9. Abdullah Z, Rathinavel K, Senthilkumar K, et al. Knowledge, attitude and practice regarding diet and nutrition among dental students. J Contemp Dent Pract. 2021;22(9):1012-1016.

10. El Tantawi M, Saleh M. Nutritional awareness among dental students in Egypt. J Dent Educ. 2015;79(3):282-288.

11. Al-Madi EM, Al-Jamie M, Al-Dukhail S. Knowledge and attitude of dental students regarding diet counseling. Saudi Dent J. 2016;28(4):207-213.

12. Thomas B, Cherian S, Thomas N. Nutrition knowledge and dietary practices among dental students in India. Indian J Dent Res. 2017;28(3):264-268.

13. Chalmuri Y, Padma TM, Pratap KVN, et al. Perception of dental students regarding diet and nutrition in oral health. J Educ Ethics Dent. 2018;8(2):54-59.

14. Al-Wesabi AA, Abdelgawad F, Sasahara H, El Motayam K. Dental students' attitudes towards nutrition and oral health. J Int Soc Prev Community Dent. 2019;9(5):470-475.

15. da Costa KLC, Tavares MR, Roncalli AG. Knowledge, attitudes and practices regarding diet and dental caries among dental students. J Dent Educ. 2020;84(5):556-562.

16. Joshipura K, Hung HC, Ritchie CS. Nutrition and oral health: lessons for dental education. Nutr Rev. 2020;78(10):790-803.

17. Brown LJ, Lewis CA, Matthews LJ. Integrating nutrition into dental curricula: a global perspective. Eur J Dent Educ. 2024;28(1):33-40.

18. Parveen R, Sharma A, Gupta N, et al. Interprofessional collaboration for dietary counseling in dentistry. J Educ Health Promot. 2023;12:19.

19. Fatima L, Al-Kuwari M, Saleh Z. Nutrition education and preventive oral care among health students. Qatar Med J. 2024;2024(1):22.

20. World Medical Association. Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-2194.

21. Kumar S, Dagli RJ, Mathur A, Jain M, Prabu D, Kulkarni S. Oral health attitudes and behavior among dental students in India: A cross-sectional study. J Int Oral Health. 2014;6(1):5–10.

22. Rajpurohit L, Pareek S, Mathur A, Jain M, Prabu D, Kulkarni S. Knowledge, attitude, and practices related to diet and oral health among Indian dental students. Indian J Dent Sci. 2020;12(3):147–152.

Multimodal Esthetic Rehabilitation of severely decayed Primary Maxillary Incisors in a Pediatric Patient using Strip Crown, Custom Made Acrylic Crowns, And A Custom Composite Build Up: A Comprehensive Case

Abstract

Background: Severe early childhood caries (ECC) often results in extensive destruction of primary maxillary incisors. Multiple aesthetic restorative options exist, but the combined use of different modalities in a single patient is rarely documented in the literature.

Case Presentation: A 5-year-old male presented with grossly decayed maxillary incisors (51, 52, 61, 62, 63). Due to difference in the remaining tooth structure after caries removal, different restorative approaches were required. Pulpectomy was performed in 51, 52, 61,62,63. Tooth 51 was restored using a stainless-steel wire question-mark shapedpost followed by composite build-up. Tooth 52 received a strip crown. Teeth 53, 61, 62, and 63 were restored with heat-cured acrylic crowns. Zinc oxide eugenol (ZOE) was used for obturation in 52,62,63 ; Endoflas FS was used in 51 and 61.

Outcomes: At a 3-month follow-up, all restorations were intact with satisfactory esthetics and good gingival health. A mild yellowish translucency was noted in tooth 61

Conclusion: A tailored, multi-technique approach allows predictable aesthetic rehabilitation of variably damaged primary incisors in the same oral cavity. Acrylic crown showed slight discolouration, whereas custom composite build up and strip crowns maintained better colour stability. Strip crown showed better aesthetics, anatomy and colour stability as compared to acrylic crown.

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INTRODUCTION

Early Childhood Caries (ECC) remains the most widespread and aggressive dental disease affecting young children, often progressing rapidly due to the unique anatomy of deciduous teeth, and behavioural issues of early childhood[1]. Defined as the presence of one or more decayed, missing, or filled tooth surfaces in any primary tooth of a child under 71 months of age, ECC disproportionately affects the maxillary primary incisors[2]. These teeth are most directly exposed to cariogenic liquids during feeding and possess thinner enamel, broader pulp chambers, and a lower mineral content—all of which increase their susceptibility to swift destruction once demineralization begins[3].

The consequences of ECC extend far beyond cavitation. As decay progresses, children may experience pain, difficulty in chewing, altered speech patterns, disturbed sleep, and poor nutritional intake[4]. The aesthetic impact is of particular concern in the anterior region, where visible tooth destruction can affect a child's confidence, emotional development, and social interaction[5]. Parents today are increasingly aware of the psychological and functional importance of preserving the appearance of primary incisors, seeking restorative options that restore both form and function[6].

Restoration of carious primary anterior teeth, however, is often challenging. Factors such as limited remaining tooth structure, close proximity to the pulp, difficulty in achieving moisture control, and varying levels of child cooperation complicate the treatment[7]. The restorative options available for primary incisors range from direct composite materials to prefabricated polycarbonate or zirconia crowns, custom-made acrylic crowns, and intracanal post-retained composite build-ups[8]. Each modality offers distinct advantages, but none is universally applicable[9]. The condition of each individual tooth - its structural integrity, pulpal status, and aesthetic importance - determines which technique will deliver the most optimal result.

In many children with ECC, different incisors present with varying severity of destruction, making a uniform approach impractical[10]. This scenario creates a clinical situation where a **multimodal, tooth-specific restorative strategy** becomes the most effective method to achieve the best results[11]. Such an approach allows the clinician to match the restorative technique to the exact structural needs of each tooth, ensuring adequate retention, natural appearance, and long-term success[12].

This case report presents a comprehensive esthetic rehabilitation of all four maxillary incisors in a 5-year-old child using **strip crown, acrylic crowns, and a custom composite buildup -** demonstrating technique selection based on loss of tooth structure, pulpal status, and aesthetic requirements[13].

CASE PRESENTATION

A 5-year-old male child reported with the chief complaint of decayed upper front teeth and dissatisfaction with their appearance (Figure 1). The parent expressed a strong desire for aesthetic correction. The child exhibited **Frankl Behaviour Rating 3**, indicating cooperative and positive behaviour suitable for chairside procedures.

Figure 1. Severely decayed maxillary anterior teeth with compromised aesthetics.

TREATMENT PLAN

Following a comprehensive clinical and radiographic evaluation, a **tooth-specific restorative strategy** was formulated based on the structural integrity and pulpal status of each incisor

Tooth	Pulp Therapy	Obturating Material	Restoration
51	Pulpectomy	Endoflas FS	Question-mark post + composite build-up
52	Pulpectomy	ZOE	Strip crown
53	No Pulpectomy	-	Acrylic crown
61	Pulpectomy	Endoflas FS	Acrylic crown
62	Pulpectomy	ZOE	Acrylic crown
63	Pulpectomy	ZOE	Acrylic crown

Treatment Procedures: Standard pulpectomy protocol was performed using hand instrumentation and saline irrigation. **Endoflas FS** was used to obturate teeth **51 and 61,** and **ZOE** was used in **52, 62, and 63**

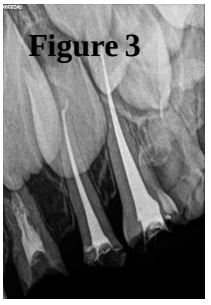

Figure 2 **Figure 3**

Pulpectomy wrt 51,5 **Pul61,62,63**

The patient was evaluated for suitability for acrylic crowns based on standard parameters - specifically, 1–1.5 mm of supragingival tooth structure, adequate overjet, and sufficient clearance for crown placement. Teeth 61, 62, and 63 met these criteria.

Minimal tooth preparation was performed to preserve the remaining structure. A **digital impression** was recorded using a Runyes intraoral scanner (Figure 4), and the scan was forwarded to the laboratory for fabrication of custom heat-cured acrylic crowns (Figure 5). The finished crowns were cemented using resin-modified glass ionomer cement (RMGIC). Uniform shade, smooth contours, and satisfactory aesthetics were achieved. (Figure 6)

Figure 4

Digital impression with Runyes intraoral

Figure 5

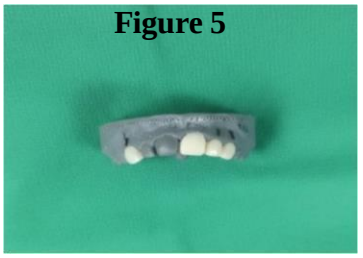

Figure 5

Acrylic crowns made on cast wrt 53,61,62,63

Figure 6

Acrylic crown cemented in 52,61,62,63 ; strip crown in 52 and composite build up wrt 51

For tooth 51 after obturation, a post space of approximately 2–3 mm was created by removing a portion of the coronal filling material (Figure 2). A 0.7–0.9 mm stainless steel wire was adapted into a question-mark configuration to act as a custom intracanal post. The coronal loop was shaped to provide mechanical support for composite retention.

The canal walls were etched with 37% phosphoric acid, thoroughly dried, and coated with bonding agent. Incremental nanohybrid composite build-up was performed, sculpted anatomically, and polished to achieve natural aesthetics and smooth surface finish.

For Tooth 52 after pulpectomy and ZOE obturation, the appropriate strip crown form was selected and trimmed. Standard etch–bond composite loading protocol was followed. The crown was seated with gentle pressure, light-cured, and the plastic crown form was removed. This provided excellent translucency and a highly natural appearance.

The patient was recalled after 3 months (Figure 6) and assessed. All restorations were intact and functional. Gingival tissues were healthy, with no bleeding, inflammation, or recession. No mobility, tenderness, or other signs of failure were noted. Composite build-up on tooth 51 remained stable. A slight yellowish discoloration was observed on tooth 61,

consistent with material characteristics of acrylic crowns. The parent expressed high satisfaction with the aesthetic outcome.

Figure 7. Follow up

DISCUSSION

This case demonstrates the practicality of combining multiple restorative techniques in a single child, selecting each restoration based on remaining tooth structure.

Aesthetic rehabilitation of extensively damaged primary maxillary incisors remains one of the most demanding tasks in Pediatric dentistry, particularly in children affected by early childhood caries (ECC)14. The clinical challenge is compounded by limited remaining tooth structure, proximity of the pulp, thin enamel, and difficulties in achieving moisture control15.

As highlighted by Jathar et al. (2018), the success of anterior full-coverage restorations in primary teeth depends heavily on careful patient selection, evaluation of supragingival tooth structure, and precise tooth preparation16. The present case exemplifies these principles, demonstrating that a multimodal restorative strategy - rather than reliance on a single technique - can produce superior functional and aesthetic results, when each tooth displays different structural needs17.

In teeth 61, 62, and 63, heat-cured acrylic crowns were selected, consistent with the recommendations of Jathar et al. (2018), who emphasized that at least 1–1.5 mm of supragingival tooth structure and adequate overjet are essential prerequisites for predictable acrylic crown retention18. Recent literature reinforces the value of custom acrylic crowns in pediatric aesthetic rehabilitation19. Jain et al. (2011) reported that custom-made PMMA crowns exhibit superior marginal adaptation and gingival compatibility because they are fabricated on individualized wax patterns, allowing anatomical precision20. Furthermore, Samaha et al. (2020) demonstrated that modern PMMA materials show improved surface hardness and wear resistance compared with older acrylic systems, though minor color changes may occur over time21. This observation aligns with the slight yellowish translucency noted in tooth 61 at follow-up in the present case, suggesting material limitations rather than clinical failure22.

Tooth 52, which retained adequate coronal tooth structure, was restored using a composite strip crown, an approach widely supported in modern Pediatric dentistry23. Strip crowns continue to be recognized as the most aesthetic restorative technique for primary incisors due to their enamel-like translucency and shade-matching capability24. Kupietzky & Waggoner (2004) reported high parental satisfaction and excellent retention when moisture control could be achieved25. Ramakrishnan et al. (2017) stated that composite strip crowns maintain long-term colour stability even under dietary and salivary challenges common in children26. The exceptional translucency and natural appearance achieved in the present case mirror the findings of these authors, reaffirming that strip crowns remain the gold standard for cases where isolation and coronal support are favourable27.

In contrast, tooth 51 presented with severe coronal loss, necessitating the use of an

intracanal post-supported composite build-up28. Recent evidence continues to support intracanal reinforcement for structurally compromised primary incisors29. Casamassimo et al. (2018) emphasized that intracanal posts enhance the mechanical stability of composite build-ups by improving stress distribution and restoring resistance form30. Bansal et al. (2020) also reported that stainless-steel or fiber posts significantly improve retention and reduce fracture incidence in primary incisors with severe coronal destruction31. The successful restoration of tooth 51 using a stainless-steel question-mark post in this case aligns with these contemporary findings, demonstrating excellent retention and structural reinforcement at follow-up32.

A consistent theme across modern Pediatric restorative literature is that no single restorative technique is universally ideal for all primary incisors33. The American Academy of Pediatric Dentistry (AAPD) 2020 Restorative Guideline strongly advocates individualized decision-making based on remaining tooth structure, aesthetic demands, and the ability to maintain isolation34. The present case reflects this philosophy, mirroring the approach of Venkataraghavan et al. (2014) who stated that successful aesthetic rehabilitation in young children "requires technique selection based on tooth-specific anatomy rather than clinician preference35." This case's combination of acrylic crowns, strip crown, and composite core-supported build-up exemplifies that principle in clinical practice36.

Furthermore, the positive 3-month follow-up, which revealed intact restorations, healthy gingiva, absence of mobility, and high parental satisfaction, confirms the validity of a multimodal approach37. The outcome is consistent with the findings of Samaha et al. (2020) and Jain et al. (2011) for acrylic crowns, Kupietzky & Waggoner (2004) and Ramakrishnan et al. (2017) for strip crowns, and Bansal et al. (2020) for post- reinforced composite build-ups38. The alignment of our clinical results with these contemporary studies strengthens the evidence that combining multiple techniques within one patient—when guided by structural and aesthetic requirements—produces predictable, durable, and highly aesthetic outcomes39. Overall, this case reinforces the modern understanding that multimodal aesthetic rehabilitation allows clinicians to address the unique challenges of each tooth while respecting the biological limitations of the deciduous dentition40. Guided by the foundational principles described by Jathar et al. (2018) and supported by recent literature from the 2000s and 2020s, this individualized restorative strategy ensured optimal function, improved facial aesthetics, restored patient and parental confidence, and promoted psychological well-being in a young child affected by ECC41.

CONCLUSION

The present case demonstrates that a tooth-specific, multimodal approach can effectively restore severely decayed primary maxillary incisors in children with early childhood caries. Careful evaluation of remaining tooth structure allowed the appropriate selection of heat-cured acrylic crowns, a strip crown, and an intracanal post-supported composite build-up, ensuring optimal retention, function, and esthetics.

The favorable follow-up findings, including stable restorations, healthy gingiva, and high parental satisfaction, indicate that combining multiple restorative techniques provides a reliable and conservative method for managing extensive anterior tooth destruction. This approach not only re-

establishes appearance and function but also contributes positively to the child's confidence and overall well-being.

REFERENCES

1. Tinanoff N, Reisine S. Update on early childhood caries. Pediatr Dent. 2020;42(3):199-204.

2. American Academy of Pediatric Dentistry. Definition of Early Childhood Caries (ECC). AAPD Reference Manual 2023.

3. Wilson PR, Beynon AD. Mineral content and structure of primary enamel. Arch Oral Biol. 1989;34(10):761-5.

4. Sheiham A. Dental caries affects children's nutrition, growth, and development. J Dent Res. 2005;84(12):1021-3.

5. Ramos-Jorge ML, et al. Impact of dental caries on quality of life in young children. Dent Traumatol. 2015;31(5):321-6.

6. Kupietzky A, Waggoner WF. Parental satisfaction with anterior esthetic restorations in children. Pediatr Dent. 2004;26(6):337-40.

7. Ram D, Peretz B. Operative challenges in restoring primary anterior teeth. Pediatr Dent. 2002;24(3):217-21.

8. Waggoner WF. Restorative options for primary incisors. Pediatr Dent. 2002;24(5):511-6.

9. Holan G, et al. Decision-making for primary incisor restorations. Dent Clin North Am. 2020;64(1):169-82.

10. Pani SC, et al. Pattern of destruction in ECC. J Clin Pediatr Dent. 2012;37(1):65-9.

11. Walia T. Multimodal restorative planning in ECC. J Indian Soc Pedod Prev Dent. 2019;37(2):124-9.

12. Sharaf AA. Long-term outcomes of intracanal restorations in primary incisors. Pediatr Dent. 2002;24(2):139-44.

13. Khatri A, et al. Acrylic crowns and composite build-ups in primary incisors. J Clin Diagn Res. 2015;9(10):ZC30-3.

14. Waggoner WF. Restorative dentistry for primary incisors. Pediatr Dent. 2002;24(5):511-6.

15. Ram D, Peretz B. Operative challenges in restoring primary anterior teeth. Pediatr Dent. 2002;24(3):217-21.

16. Jathar M, et al. Heat-cure acrylic crowns for primary incisors: indications and technique. J Indian Soc Pedod Prev Dent. 2018;36(1):35-41.

17. Walia T. Multimodal restorative decision-making in ECC. J Indian Soc Pedod Prev Dent. 2019;37(2):124-9.

18. Jathar M, et al. Heat-cure acrylic crowns: clinical requirements. J Indian Soc Pedod Prev Dent. 2018;36(1):35-41.

19. Samaha A, et al. PMMA materials in pediatric crowns. J Prosthet Dent. 2020;123(4):680-7.

20. Jain M, et al. Custom PMMA crowns for primary incisors. J Clin Pediatr Dent. 2011;36(1):27-32.

21. Samaha A, et al. Wear resistance of new-generation PMMA. J Prosthet Dent. 2020;123(4):680-7.

22. Sharma A, et al. Color stability of PMMA crowns in pediatric dentistry. J Dent Child. 2019;86(2):72-8.

23. Waggoner WF. Strip crowns in pediatric esthetics. Pediatr Dent. 2002;24(5):511-6.
24. Clark L, Wells MH. Esthetic pediatric crowns overview. J Dent Child. 2014;81(3):178-85.

25. Kupietzky A, Waggoner WF. Parental satisfaction with strip crowns. Pediatr Dent. 2004;26(6):337-40.

26. Ramakrishnan M, et al. Color stability of composite strip crowns. J Clin Pediatr Dent. 2017;41(3):218-22.

27. Ram D, Fuks A. Aesthetic rehabilitation using strip crowns. Int J Paediatr Dent. 2006;16(3):193-8.

28. Mortada A, King NM. Post-retained composites for primary incisors. J Clin Pediatr Dent. 2004;28(2):145-50.

29. Sharaf AA. Intracanal reinforcement in primary teeth. Pediatr Dent. 2002;24(2):139-44.

30. Casamassimo PS, et al. Restorative stability with intracanal posts. Pediatr Dent. 2018;40(3):180-6.

31. Bansal R, et al. Retention of fiber/stainless steel posts in primary teeth. J Indian Soc Pedod Prev Dent. 2020;38(3):223-9.

32. Moskovitz M, et al. Intracanal posts improve restoration longevity. Int J Paediatr Dent. 2005;15(5):342-8.

33. Holan G, et al. Decision-making in primary incisor restoration. Dent Clin North Am. 2020;64(1):169-82.

34. American Academy of Pediatric Dentistry. Restorative Dentistry Guideline. AAPD. 2020.

35. Venkataraghavan K, et al. Tooth-specific approach in pediatric esthetic rehabilitation. Int J Clin Pediatr Dent. 2014;7(3):165-71.

36. Seale NS, Randall R. Pediatric restorative principles. Pediatr Dent. 2020;42(4):215-28.

37. Samaha A, et al. PMMA clinical follow-up. J Prosthet Dent. 2020;123(4):680-7.

38. Jain M, Kupietzky A, Bansal R, Ramakrishnan M. Various restorative outcomes in primary incisors. Multiple sources (2011–2020).

39. Gugnani N, et al. Predictability of multimodal esthetic rehabilitation. Eur Arch Paediatr Dent. 2017;18(3):187-95.

40. Pinkham JR, Casamassimo PS. Pediatric Dentistry: Infancy through Adolescence. 6th ed. Elsevier; 2019.

41. Jathar M, et al. Foundations of pediatric esthetic rehabilitation. J Indian Soc Pedod Prev Dent. 2018;36(1):35-41. Standard

THE EXTRA ROOT STORY – RADIX ENTOMOLARIS: A CASE REPORT

Abstract

Typically, the first mandibular molars possess one mesial and one distal root; however, anatomical variations may occur in which the number of roots and canals differs. The presence of an additional distolingual root in these molars is termed radix entomolaris (RE). Accurate diagnosis prior to initiating root canal therapy in such teeth is essential to achieve a successful treatment outcome. This report presents the endodontic management of a mandibular molar exhibiting radix entomolaris.

Introduction:

The primary objective of endodontic therapy is to eradicate microorganisms from the root canal system and prevent subsequent reinfection. This is accomplished through thorough biomechanical cleaning of the pulp chamber, followed by a hermetic seal using suitable obturating material.A detailed understanding and awareness of atypical root canal morphology are crucial for achieving successful endodontic outcomes. Generally, the mandibular first molars consist of one mesial and one distal root, with two mesial canals and one distal canal.[1,2]In most cases, the mesial root contains two canals that may either open into separate apical foramina or converge into a single foramen at the root apex. The distal root usually possesses a single, bean-shaped canal. However, during endodontic treatment, variations in the number of roots and root canals in mandibular molars have been noted, although such cases are uncommon. Carabelli was the first to describe the presence of an additional root in the mandibular first molar, referring to it as radix entomolaris (RE).[3]This additional third root is most commonly located on the distolingual aspect. The radix entomolaris may appear in the first, second, or third mandibular molars, with the second molar showing the lowest frequency of occurrence. When an extra root is situated on the mesiobuccal side, it is termed radix paramolaris. Studies indicate that RE is present in less than 5% of white Caucasian, African, Eurasian, and Indian populations, while its prevalence ranges between 5–30% in individuals with Mongoloid traits, such as Chinese, Eskimos, and Native Americans.[4–7] This article emphasizes the clinical identification and endodontic management modifications required for mandibular first molars exhibiting radix entomolaris.

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MORPHOLOGY

1. Classification of Radix Entomolaris (RE) by Carlsen and Alexandersen

Carlsen and Alexandersen proposed a classification for radix entomolaris based on the position of its cervical portion, dividing it into four distinct types:

Type A: The cervical portion is positioned distally, and two normal distal root components are present.

Type B: Similar to Type A, but only one typical distal root component exists.

Type C: The cervical part is situated mesially.

Type AC: The cervical portion lies between the mesial and distal root components.

2. Classification by De Moor et al. (Based on Root Curvature in Buccolingual Direction)

De Moor and colleagues categorized radix entomolaris according to the curvature pattern observed in the buccolingual plane:

Type I: The root or root canal runs straight without curvature.

Type II: The root canal begins with a curved entry but continues as a straight canal.

Type III: The root canal exhibits two curvatures—an initial curvature in the coronal third and a secondary buccal curvature extending from the middle to the apical third.

3. Classification by Wang et al. (Based on Radiographic Appearance)

Wang and co-researchers recently introduced another system that classifies radix entomolaris according to its visibility on radiographs:

Type 1: The root displays a clearly distinguishable radiographic outline.

Type 2: Identification requires a considerable change in the X-ray beam angle, either mesially or distally.

Type 3: The root merges with the adjacent distobuccal root, making radiographic detection very challenging.

4. Classification of Radix Paramolaris (RP) by Carlsen and Alexandersen

Carlsen and Alexandersen also categorized radix paramolaris based on the position of its cervical portion:

Type A: The cervical portion of RP is located on the mesial root complex.

Type B: The cervical portion is positioned centrally between the mesial and distal root complexes.

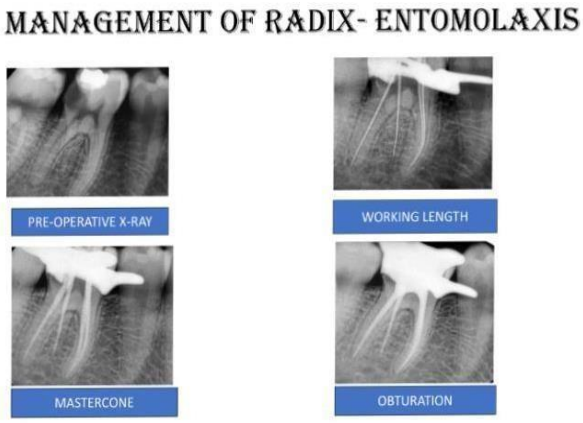
CASE REPORT

A 22-year-old female patient presented to the Department with a chief complaint of persistent pain in the lower leftt posterior tooth for approximately one month. Clinical examination revealed deep caries in the mandibular left first molar, and a definitive diagnosis of irreversible pulpitis was established. Radiographic assessment indicated the presence of an additional (third) root without any evident periapical pathology.

Endodontic therapy was planned for the affected tooth following informed consent. After administration of local anesthesia, an access cavity was prepared, and the canal orifices were explored using a DG-16 explorer. A fourth canal orifice was identified in the distolingual position, distinctly separated from the other three

canals. The working lengths were determined radiographically using a #10 K-file. Cleaning and shaping were performed with the ProTaper rotary system, with apical enlargement up to file F2. Irrigation was carried out using 1.3% sodium hypochlorite during instrumentation, followed by 17% EDTA as the final rinse for smear layer removal. A temporary restoration was placed, and the patient was recalled after four days .

At the follow-up visit, the patient was asymptomatic. After confirming dryness of the canals with sterile paper points, a master cone radiograph was taken. Obturation was performed using gutta-percha cones with AH Plus sealer (Dentsply DeTrey, Germany), and the access cavity was sealed appropriately



DISCUSSION

The success of root canal therapy primarily relies on the clinical triad—accurate diagnosis, proper chemomechanical preparation, and three-dimensional obturation of the canal system.

Among these, establishing the correct diagnosis is a crucial initial step in achieving successful endodontic outcomes. One of the major reasons for treatment failure is the incomplete removal of pulpal tissue or microorganisms from all root canals. Therefore, precise radiographic evaluation plays a vital role in ensuring complete canal debridement and overall treatment success.[8]

To reduce the risk of missed canals, radiographs should be taken from multiple angulations.[9] The occurrence of radix entomolaris (RE) is relatively uncommon, with a reported prevalence of less than 5% in the Indian population. The exact cause of RE remains uncertain; however, some authors attribute it to developmental disturbances during odontogenesis or strong genetic influence.[10]

To prevent iatrogenic errors, it is essential to obtain at least two diagnostic radiographs at different angulations, supplemented with a thorough clinical examination. When RE is identified before treatment, modifying the access cavity into a trapezoidal form allows better visualization and location of the additional canal orifice.

Adhering to the law of symmetry and employing adjunctive techniques such as visual inspection of the dentinal map, identifying bleeding points, magnification, using ultrasonic tips, applying 1% methylene blue dye, performing the champagne bubble test, and utilizing cone beam computed tomography (CBCT) imaging can greatly assist in locating missed canals.

De Moor *et al.*[9] investigated the morphology of RE and found that these additional roots frequently exhibit curvature. Therefore, careful exploration using small files (size #10 or smaller), along with accurate determination of canal curvature and working length radiographically, is essential. Establishing straight-line access and preparing an adequate glide path are critical steps to minimize procedural complications.

CONCLUSION

The intricate anatomy of the root canal system often challenges clinicians during endodontic treatment. Missing an RE can significantly compromise treatment prognosis. Hence, preoperative radiographs taken at approximately 30° mesial and distal angulations, combined with meticulous interpretation, are indispensable for accurate diagnosis. A comprehensive understanding of root canal morphology, prevalence, and canal configuration variations associated with radix entomolaris is essential for ensuring endodontic success.

REFRENCE

1. Vertucci FJ. Root canal anatomy of the human permanent teeth. Oral Surg Oral Med Oral Pathol. 1984;58(5):589–599. Doi:10.1016/0030-4220(84)90085-9.

2. Barker BC, Parsons KC, Mills PR, Williams GL. Anatomy of root canals. III. Permanent mandibular molars. Aust Dent J. 1974;19(6):408–413. Doi:10.1111/j.1834-7819.1974.tb02372.x.

3. Calberson FL, De Moor RJ, Deroose CA. The radix entomolaris and paramolaris: clinical approach in endodontics. J Endod. 2007;33(1):58–63. Doi:10.1016/j.joen.2006.05.007.

4. Tratman EK. Three-rooted lower molars in man and their racial distribution. Br Dent J. 1938;64:264–274.

5. Curzon ME, Curzon JA. Three-rooted mandibular molars in the Keewatin Eskimo. J Can Dent Assoc (Tor). 1971;37:71–72.

6. Turner CG 2nd. Three-rooted mandibular first permanent molars and the question of American Indian origins. Am J Phys Anthropol. 1971;34(2):229–241. Doi:10.1002/ajpa.1330340207.

7. Yew SC, Chan K. A retrospective study of endodontically treated mandibular first molars in a Chinese population. J Endod. 1993;19(9):471–473. Doi:10.1016/S0099-2399(06)80536-4.

8. Abella F, Patel S, Duran-Sindreu F, Mercadé M, Roig M. Mandibular first molars with distolingual roots: review and clinical management. Int Endod J. 2012;45(11):963–978. Doi:10.1111/j.1365-2591.2012.02075.x.

9. De Moor RJ, Deroose CA, Calberson FL. The radix entomolaris in mandibular first molars: an endodontic challenge. Int Endod J. 2004;37(11):789–799. Doi:10.1111/j.1365-2591.2004.00870.x.

10. Calberson FL, De Moor RJ, Deroose CA. The radix entomolaris and paramolaris: clinical approach in endodontics. J Endod. 2007;33(1):58–63. Doi:10.1016/j.joen.2006.05.007

Pseudo Class III Malocclusion: Navigating the Treatment Tangle- A Case report

Abstract

Pseudo-Class III malocclusion is a functional anomaly characterized by anterior displacement of the mandible resulting from premature dental interferences, often leading to an anterior crossbite. Unlike true skeletal Class III malocclusion, this condition arises due to occlusal discrepancies rather than inherent skeletal abnormalities. The diagnosis of pseudo-Class III malocclusion remains challenging due to overlapping clinical features and the lack of well-defined diagnostic criteria.This case report discusses the diagnostic distinctions between pseudo and skeletal Class III patterns, emphasizing clinical assessment methods such as evaluation of centric relation (CR) versus habitual occlusion (HO), molar and canine relationships, and growth analysis parameters (OP and LAFH/TFH ratios). Guidelines for early intervention and appliance selection based on the patient's growth stage and malocclusion type are outlined, highlighting the importance of functional and skeletal differentiation .This case reports are presented to illustrate clinical features, diagnostic reasoning, and treatment outcomes achieved through early orthodontic intervention. The findings underscore that timely identification and management of pseudo-Class III malocclusion are crucial in interceptive orthodontics, as early correction of functional shifts can redirect growth, prevent progression to skeletal Class III discrepancies, and reduce the need for future surgical correction.

Keywords: **Pseudo-Class III malocclusion, anterior crossbite, interceptive orthodontics, functional shift, early intervention, growth modification.**

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INTRODUCTION

A precise diagnostic of the skeletal and dental components of a specific malocclusion is necessary to determine the best course of treatment and when to implement it. In those with Class III malocclusion, skeletal and dentoalveolar components may co-exist. The features of skeletal Class III malocclusion have been thoroughly examined and compared to either Class I malocclusion or normal occlusion. These characteristics can be summed up as follows: dentoalveolar components with retroclined mandibular incisors and proclined maxillary incisors to achieve dentoalveolar compensation; skeletal components with an undeveloped maxilla, an overdeveloped mandible, or both. The different components of skeletal Class III had to be considered in order to properly address the underlying cause of the discrepancy[1]. An anterior crossbite resulting from a forward functional displacement of the mandible is a characteristic of pseudo-Class III malocclusion. The mandibular incisors are proclined and spaced, the maxillary incisors exhibit retroclination, and the mesial step in the mixed dentition cannot be greater than 3 mm. Patients typically exhibit an end-to-end incisor relationship when directed into a centric relationship, which involves performing a forward functional mandibular shift as a result of a muscle reaction to allow the posterior teeth to occlude. Because of this, this kind of malocclusion has been referred to as a pseudo- or functional Class III malocclusion[2,3]. For appropriate oral and maxillofacial growth, face aesthetics, and sound psychological development, early intervention is essential in cases of severe skeletal Class III malocclusion. Additionally, it shortens the period of treatment and simplifies treatment approaches. Even better outcomes may arise from prompt intervention. As a result, early treatment of Class III malocclusion is a critical duty for orthodontists and a major area of competence in orthodontics. Additionally, encouraging the child's compliance during the course of therapy and maintaining efficient contact with parents to guarantee their understanding and support are essential elements that can have a major impact on the treatment's overall effectiveness. Early therapy of Class III malocclusion should completely consider the unexpected nature of the malocclusion's evolution and the probable variety in treatment outcomes[4]. In 1899, Edward Hartley Angle, the father of modern orthodontics, divided malocclusions into Class I, Class II, and Class III according on the permanent first maxillary and mandibular molars' relationship and the alignment—or lack thereof—of teeth with respect to the line of occlusion. One Angle's classification was gradually changed, and new details like the link between the jaw and the growth pattern were included. Therefore, a Class III jaw relationship indicates that the mandible has moved closer to the maxilla and/or cranial base. There may occasionally be a Class I dental relationship on the Class III skeletal base as a result of dental compensation[5,6,7].

Clinically, patients exhibit a normal facial profile in centric relation and a slightly concave profile in habitual occlusion, with Class I molar and canine relationships in centric relation but Class III tendencies in habitual occlusion. Functional mandibular shift of varying magnitude is observed. Functional assessment, including evaluation of CO–CR discrepancy, overjet, and facial proportions (OP and LAFH/TFH ratios), helps distinguish pseudo-Class III from true skeletal discrepancies.

DIAGNOSIS AND TREATMENT PLAN

A 15-year-old male presented with the chief complain of forwardly placed teeth in lower front tooth region and irregularly placed teeth in upper front tooth region . He had straight profile and in-competent lips

Intraorally, Class III molar relationship and Class III canine relationship were present bilaterally with reverse overjet of -2mm and overbite of -3mm. Lower midline to upper midline was shifted to left side by 2mm &upper midline to face was slightly shifted to right side. (Fig:- 1 & Fig :- 2). Treatment plan was to extract the 34. Use of cross-elastics and fixed appliance therapy to correct anterior crossbite and align dentition

Fig:1- Extra-oral Photographs

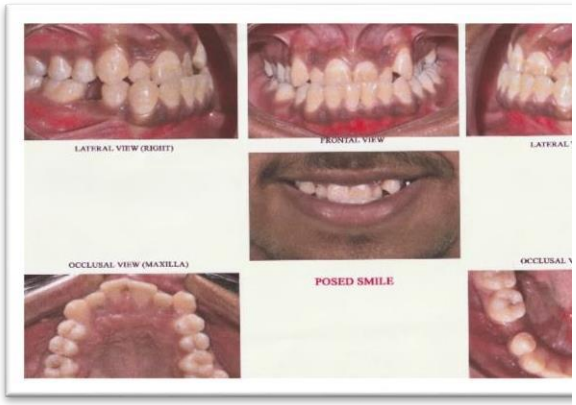


Fig:2- Intra-oral Photographs

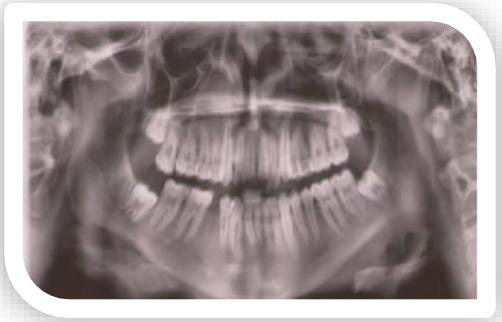


Fig:3- (OPG) & Fig:4- Lateral cephalogram.

OPG reveals - All the 3rd molars are present and missing 45. Lateral cephalogram – It shows Growth is completed, Incisors are in cross bite, and Incompetent lips is present .

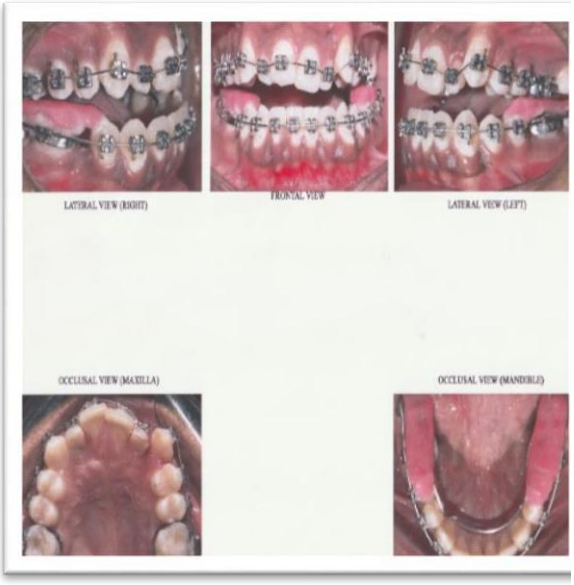
TABLE1:- PRE- AND POSTTREATMENT

MEASUREMENT	PRETREATMENT	POSTTREATMENT
SNA	76º	75º
SNB	80º	78º
ANB	-4º	-3º
IMPA	91º	89º

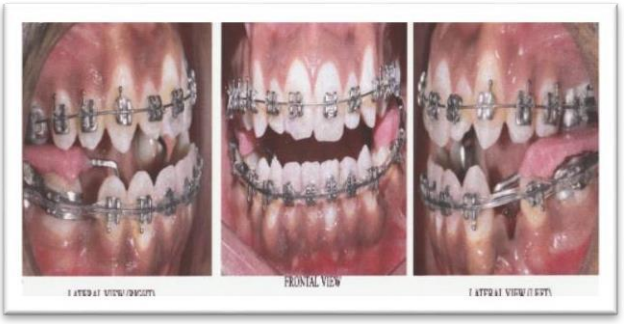
WIT AO & BO	7mm BO is ahead of AO	5mm BO is ahead of AO
BETA ANGLE	46º	39º
YEN ANGLE	132º	130º

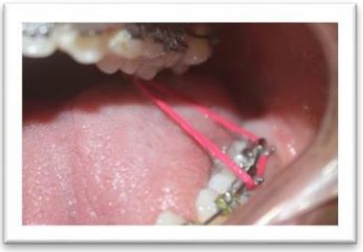
TREATMENT PROGRESS:-

Stage treatment intra-oral



Stage 1:- Upper and Lower bonding was done and fixed posterior bite block was given.





INTRAORALFINISHING PHOTOGRAPHS

Stage 2:- After 3month of Levelling and Alignment. Extraction of 34 was done and space closure in lower arch was done with continuous E-Chain. Cross elastics were given to correct the posterior cross bite.

Stage 3:- After 8 Months Positive overjet was achieved, and Class III elastics were used.

Post Treatment Intraoral an Extraoral photographs

Post Treatment :-patient after 11 Months. Treatment was completed.

Outcome:- Achieved Class I Occlusion with improved facial esthetics and stable results.

Post Treatment:- OPG and Lateral cephalogram

Discussion

Early diagnosis of pseudo-Class III malocclusion allows orthodontists to manage functional shifts before skeletal patterns develop. Interceptive treatment during the mixed dentition period helps redirect growth and prevents severe skeletal discrepancies. Functional therapy, occlusal adjustment, and orthopedic appliances play vital roles in managing these cases effectively. Delayed or incorrect diagnosis may lead to irreversible skeletal changes requiring complex orthodontic-surgical treatment. Therefore, differentiating pseudo-Class III from true skeletal Class III through careful clinical and functional analysis is essential. All pseudo–Class III malocclusion cases showed Class I dental and skeletal relationship during the

follow-up period that extended until after the growth spurt. Treatment of a pseudo-Class III malocclusion must be performed as soon as it is detected and should be considered as a Class III malocclusion[1]; however, the clinician is unfortunately not always able to evaluate the patient during the developmental stage of this type of malocclusion. Anterior crossbite has been associated with a variety of complications, such as gingival recession of the lower incisors, incisal wear, and worsening of the growth pattern; correcting an anterior crossbite consequently increases the maxillary arch perimeter, offering more space for the canines and premolars to erupt and therefore a more stable orthopedic result [4–7]. The functional appliances used to treat Class III malocclusion work by permitting the eruption of the maxillary molars and maintaining the mandibular ones in position leading to an occlusal plane rotation that helps shift the molar relationship from Class III to Class I .

References

1. Rabie AB, Gu Y. Diagnostic criteria for pseudo-Class III malocclusion. Am J Orthod Dentofacial Orthop. 2000;117(1):1-9.

2. Nanda R. Esthetics and Biomechanics in Orthodontics. 2nd ed.

3. Reyes A, Serret L, Peguero M, Tanaka O. Diagnosis and treatment of pseudo-Class III malocclusion. Case Rep Dent. 2014;2014:1-7.

4. Zhou X, Chen S, Zhou C, et al. Expert consensus on early orthodontic treatment of Class III malocclusion. Int J Oral Sci. 2025;17-20.

5. Zere E, Chaudhari PK, Sharan J, Dhingra K, Tiwari N. Developing Class III malocclusions: challenges and solutions. Clin Cosmet Investig Dent. 2018;10:99-116.

6. Ngan P, Moon W. Evolution of Class III treatment in orthodontics. Am J Orthod Dentofacial Orthop. 2015;148(1):22-36.

7. Sugawara J. Clinical practice guidelines for developing Class III malocclusion. In: Nanda R, editor. Biomechanics and Esthetic Strategies in Clinical Orthodontics. Philadelphia: WB Saunders; 2005. p. 211-242.

Bilateral Radix Entomolaris in Deciduous Mandibular Molar: A Rare Case Report

Abstract

INTRODUCTION: A supernumerary root is a developmental defect that can affect treatment planning and is also known as 'Radix entomolaris' (RE). Mandibular first molars mostly have two roots and three to four root canals. Due to the developmental disturbances, the number of root canals and the number of roots may vary.

CASE REPORT:

A 4-year-old patient presented with a complaint of pain in the lower left and right back tooth region for one month. On clinical examination, deep occlusal caries was evident in 74 cases, and secondary caries in 84 cases. On radiographic examination, an extra root was seen present with the distal root in the left and right primary mandibular first molar tooth.

DISCUSSION:

Appropriate diagnosis is a requisite before starting the root canal procedure in these teeth to ensure a successful treatment outcome. The presence of three roots in deciduous mandibular first molars is relatively rare, and only a few cases have been documented.

CONCLUSION:

Early recognition and appropriate modification of treatment protocols are essential for successful endodontic results in patients. Appropriate radiographic investigations are a requirement for a definitive diagnosis of radix entomolaris.

KEYWORDS: Radix entomolaris, endodontic, Primary mandibular first molar, extra root

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INTRODUCTION

A supernumerary root is a developmental anomaly that can affect treatment planning as well as the prognosis of any tooth and is known as 'Radix entomolaris' (RE). Mandibular first molars generally have two roots and three to four root canals. Due to developmental disturbances, the number of root canals and the number of roots may differ. Radix entomolaris (RE) is also known as an "extra third root" or "distolingual root" or "extra distolingual root". It was found that the presence of an uncommon third root in mandibular molars, called radix entomolaris by Mihaly Lenhossek and radix paramolaris by Bolk, is located distolingually and mesiobuccally, respectively. Based on the location of its cervical portion, radix entomolaris can be classified as

• Type A – Distally located cervical part with two normal distal root units.

• Type B – Same as type A, but only one normal distal unit.

• Type C – Mesially located cervical unit.

• Type AC – Location between mesial and distal root units.

Tratman reported in 1938 that three-rooted mandibular molars are frequently seen in permanent molars but have a rare frequency of <1% in the deciduous dentition. Among them, primary second molars present a higher prevalence (27.8%) than primary first molars (9.7%).
However, the etiology of supernumerary roots is unknown. It has been proposed that if, during the development of the root, the epithelial sheath of Hertwig is disrupted, it can lead to the formation of an accessory/supernumerary root canal.

CASE REPORT

A 4-year-old Male patient, accompanied by his parents, presented to the department of pediatric and preventive dentistry of Mithila Minority Dental College and Hospital with the chief complaint of pain in the lower left and right back tooth region for 1 week. Pain was spontaneous, sudden in onset, localized, aggravated on taking hot/cold food substances, and relieved on taking medication. No relevant medical or dental history was recorded. Restoration of 84 was previously done. On intra-oral examination, a complete primary dentition was present with deep occlusal caries wrt 74 and initial occlusal caries wrt 75. Suggested RadioVisioGraphy (RVG) revealed a radiolucency involving enamel, dentin, and pulp, with no periradicular or furcal changes, along with an additional distolingual root in both 74 and endodontically treated 84 with furcal radiolucency. Correlating clinical and radiographic findings, a diagnosis of chronic irreversible pulpitis with radix entomolaris wrt 74 and furcal abscess wrt 84. Pulpectomy was planned for tooth 74, and re-pulpectomy for tooth 84.

PRE OPERATIVE PHOTO

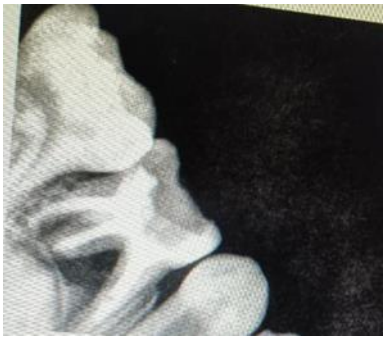
RVG WRT 74

OBTURATION WRT 74

RVG WRT 84

WORKING LENGTH WRT 84

WORKING LENGTH WRT 74



OBTURATION WRT 84

S.S.CROWN WRT 74

S.S.CROWN WRT 84

DISCUSSION

From the clinical point of view, it is very important for a clinician to know about an anatomical variation and knowledge of the teeth present. The presence of three roots in the deciduous mandibular first molar is relatively rare, and only a few cases have been reported. Documented literature reveals that there is 15.2% of higher incidence rate in the population of Mongolian origin. Usually, the distal root and the RE lie in the same buccolingual plane. Therefore, on a diagnostic radiograph, superimposing roots might be seen, resulting in an incorrect interpretation. To confirm the supernumerary root, another radiograph with a greater mesial or distal horizontal angulation (20-30 degrees) proves useful. The first case was reported by Winkler and Ahmad in 1997, followed by two more cases reported by Gupta et al. and Ramamurthy et al. in the Indian population. According to De Moor, the morphology of the radix entomolaris canals in the majority of cases was curved. Hence, after initial root canal exploration with small files (size 10 or less), together with radiographic working length and curvature determination. The creation of straight-line access and preparation of the glide path have to be emphasized to avoid procedural errors. Pediatric dentists might encounter various challenges in treating primary teeth with RE. Having known the complex root canal system of primary molars, remnants of pulp leftover within the RE due to missed canals might hinder the pediatric endodontic success rate.

CONCLUSION

An accurate diagnosis by correlating clinical and radiological investigations made possible by normal and abnormal morphological anomalies of human

dentition by pediatric dentists. Early identification and appropriate modification of treatment protocols are essential for successful endodontic outcomes in pediatric patients. Appropriate radiographic investigations are necessary for a definitive diagnosis of RE.

REFERENCES

1. Winkler MP, Ahmad R. Multirooted anomalies in the primary dentition of Native Americans. J Am Dent Assoc. 1997; 128:1009-11
2. Gupta S, Nagaveni NB, Chandranee NJ. Three rooted mandibular first primary molar: Report of three cases. Contemp Clin Dent. 2012; 3(suppl 1):S134-6
3. De Moor RJ, Deroose CA, Calberson FL. The radix entomolaris in mandibular first molars: an endodontic challenge. Int Endod J. 2004; 37:789-99
4. Nagaveni, NB; Umashankara, KV[1]. Radix entomolaris and paramolaris in children: A review of the literature. Journal of Indian Society of Pedodontics and Preventive Dentistry 30(2):p 94-102, Apr–Jun 2012.
5. Calberson FL, De Moor RJ, Deroose CA. The radix entomolaris and paramolaris: clinical approach in endodontics. J Endod. 2007; 33:58-63.
6. Rani R (2019) Unilateral radix entomolaris in primary first molar: A rare entity. IJADS 5(3):297-298.
7. Carabelli G. Systematisches Handbuch Der Zahnheikunde. 2nded. Vienna: Braumuller and Seidel, 1844, 114.
8. Yadav S, Mishra P, Marwah N, Goenka P. Bilateral multirooted first primary molar: A rare case report. J Indian Acad Oral Med Radiol. 2017; 29:63-6.

Surgical Management of impacted Supernumerary Tooth : A Case Report

Abstract

Supernumerary teeth in the anterior maxillary region can lead to a variety of complications including pain, delayed eruption, crowding, root displacement and aesthetic concerns. This case report describes the surgical management of a palatally placed supernumerary tooth in the anterior maxilla of a 13-year-old male, who presented with chief complaint of pain in the upper front teeth region for one year.

Introduction:

Supernumerary teeth (hyperdontia) are defined as additional teeth beyond the normal dental complement. They are most frequently located in the maxillary anterior region, particularly in the pre-maxilla (the region of the incisors). Their morphology may vary (conical, tuberculate, supplemental) and their position may be erupted or impacted, buccally or palatally placed. When present, they may cause complications such as delayed eruption or impaction of permanent teeth, crowding or displacement, root resorption of adjacent teeth, diastema, cyst formation or aesthetic/functional disturbances. In particular, palatally located supernumerary teeth (commonly known as palatal mesiodens) pose surgical access challenges and may delay recognition, thereby increasing risk of complications.

This case presents the surgical management of a palatal supernumerary tooth in the anterior maxilla in a teenage patient with a one-year history of pain in the upper front teeth region.

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CASE REPORT

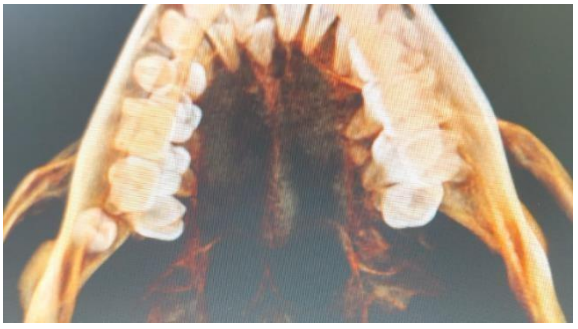
Patient Information: A 13-year-old male patient comes to the department of pediatric and preventive dentistry of Mithila minority dental college and hospital with chief complaint of pain in the upper front tooth region since one year. The patient reported intermittent mild pain in the area of the upper incisors, aggravated on biting or tapping. No any medical history (no systemic disease, no syndromic features, no history of trauma to the region).

Clinical Examination: Extra-oral examination was unremarkable. Intra-oral examination revealed:

- The permanent maxillary incisors were present and aligned.
- On palpation of the palatal mucosa behind the central incisors, a slight bulge was detected between the root region of the maxillary central incisors, indicating a possible palatal mass.
- The adjacent incisors tested vital (cold/pulp testing), but there was mild tenderness on percussion of the left central incisor, with mild mobility.
- There was no overt diastema and crowding in the anterior maxilla was observed.

Radiographic Assessment: A periapical radiograph of the upper anterior region showed a radiopaque tooth-like structure located palatal to the roots of the maxillary central incisors, with the crown oriented toward the palatal shelf and the root directed labially. Considering the radiographic finding, a cone-beam computed tomography (CBCT) scan was obtained to better visualize the 3-dimensional position, orientation, relation to adjacent roots, and to plan surgical access. The scan confirmed a single supernumerary tooth located palatally between the two central incisors, with its crown in close proximity to the palatal cortical bone and its root apex near the labial root surface of the right central incisor, without root resorption.

PRE OP IOPA



PRE OP CBCT

Diagnosis: palatally impacted mesiodens.

Treatment Planning: After discussion with the patient and his guardians, the treatment plan was formulated to surgically remove the supernumerary tooth via a palatal approach under local anaesthesia, with careful protection of the adjacent permanent incisors and minimal invasiveness.

SURGICAL PROCEDURE:

FLAP RAISED

EXTRACTED

SUTURE PLACED

SUTURE REMOVED AFTER 1 WEEK

POST OPERATIVE PHOTOGRAPH

DISCUSSION

The occurrence of supernumerary teeth in the anterior maxilla is common, and palatal location is frequent. For example, in a retrospective study using CBCT, 84.6 % of supernumerary teeth in the anterior maxilla were palatal in position. Surgical removal is recommended when the supernumerary tooth causes or may cause complications: delayed eruption, displacement of adjacent teeth, root resorption, orthodontic issues or pain. The surgical approach (palatal vs buccal) depends on the position; a palatal approach is often indicated for palatally located teeth and has been shown to be safe with minimal complications if properly performed. In our case, the one-year history of pain in the upper front region could be attributed to pressure effect of the palatally positioned supernumerary tooth leading to mild periapical irritation or interference with adjacent teeth. Early recognition and removal prevented further sequelae (such as root resorption or eruption delay). Flap design and bone removal must be performed carefully to minimize trauma to adjacent teeth and their roots, preserve vitality, and maintain periodontal health. In our case, no vitality loss was seen in adjacent incisors.
The timing of removal is also important; although screening for supernumerary teeth is commonly done at mixed dentition stage, surgical intervention at early adolescent age (as in this 13-year-old) is still effective in reducing complications.
Following removal, monitoring is essential for adjacent teeth eruption, alignment, vitality and the need for orthodontic or orthodontic-surgical interventions.

CONCLUSION

This case report demonstrates the successful surgical management of a palatally placed supernumerary tooth in the anterior maxilla of a 13-year-old male with chronic pain in the upper front teeth region. Early diagnosis, appropriate imaging (including CBCT), careful surgical planning and execution, and post-operative follow-up contributed to a favourable outcome with resolution of symptoms, preservation of adjacent tooth vitality, and no complications.

REFERENCES

1. Maddalone M, Rota E, Amosso E, Porcaro G, Mirabelli L. Evaluation of surgical options for supernumerary teeth in the anterior maxilla. *Int J Clin Pediatr Dent.* 2018;11(4):294-298. PubMed
2. Ahammed H, Seema T, Deepak C, et al. Surgical Management of Impacted Supernumerary Tooth: A Case Series. *Int J Clin Pediatr Dent.* 2021;14(5):726-729. PMC
3. Acharya S. Supernumerary Teeth in Maxillary Anterior Region: Report of Three Cases and Their Management. *Indian J Surg Sci.* 2015. ijss-sn.com
4. Lykousis A, Pouliezou I, Christoloukas N, Rontogianni A, Mitsea A, Angelopoulos C. Supernumerary teeth in the anterior maxilla of non-syndromic children and adolescents: a retrospective study based on CBCT scans. *Pediatr Rep.* 2025;17(3):52. MDPI

Depigmentation by scalpel and Surgical Crown Lengthening to Improve Esthetics of gingiva in anterior region.

Abstract

A smile is a captivating way to convey happiness, accomplishment, civility, and self-assurance. The gingival architecture influences the smile's harmony in addition to the teeth's position, shape, and color. An attractive smile is mostly dependent on gingival tissues. Highly pigmented gingiva may have contributed to this lovely smile's grace. Melanoblasts create the melanin granules that cause this gingival coloring. People with moderately pigmented gingiva frequently seek cosmetic therapy even though melanin pigmentation does not pose a health risk. This case report describes an instance of severe gingival display and hyperpigmentation that was treated with gingival depigmentation utilizing the scalpel approach and anterior crown lengthening.

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INTRODUCTION

Nowadays, aesthetics play a big role in dentistry, and doctors are increasingly focused on attaining it. A beautiful gingiva that appear healthy are a crucial element. The way the teeth are framed inside the gingival architecture greatly affects the smile's appearance. The ideal aesthetic grin is said to include a conservative display of two to three millimeters of keratinized tissue. [1,2] On the other hand, excessive gingival show can seriously harm a person's attractiveness. When smiling, the inferior border of the upper lip should ideally be at the level of the apices of the six maxillary anterior teeth. Maxillary canines and central incisors should have their gingival apices at the same level, whereas the lateral incisors should fall slightly below the imaginary line connecting the apices of the canines and the central incisor. A range of up to 3 mm above the gingival zenith is considered aesthetically pleasing.[3] The excessive gingival display is commonly associated with vertical maxillary excess, gingival correction of vertical maxillary excess requires osseous resection surgeries whereas excessive gingival display due to gingival enlargement or altered passive eruption can be effectively corrected by gingivectomy procedures.[4] Certain populations exhibit gingival hyperpigmentation, which can be linked to hereditary characteristics. Gingival pigmentation is caused by melanoblasts, which are non-keratinocytes. [5] This pigmentation is not gender-specific and can occur in people of any race or age. [6–8] Table 1 lists the several methods that can be used to treat hyperpigmentation and excessive gingival show. Individual preferences and clinical experience should be taken into consideration while choosing a technique. [9]

CASE REPORT

The orthodontics department referred a 19-year-old female patient in good health for a smile line correction. The patient's prior dental history indicated that they had received orthodontic treatment for Angle's class II division two malocclusion in the first quadrant with a maxillary canine that has erupted facially [Figure 1]. The patient had a class I smile line in reference to the maxillary anterior region during the intraoral examination. An examination of the soft tissues showed persistent, widespread marginal gingivitis. The term "class I smile line" describes a very high smile line, meaning that there is more than 2 mm of marginal gingiva visible or more than 2 mm of decreased but healthy periodontium visible apical to the cemento-enamel junction. [1] When compared to the anatomic crown, the maxillary anteriors' apico coronal distance was much shorter.

Fig 1- pre-operative picture

PROCEDURE

The patient gave their consent before the surgical operation started. After anesthetizing the surgical site, bleeding spots on the maxillary labial surface that stretched from the left premolar to the right premolar region were marked with a pocket marker. Using a No. 15 Bard Parker blade, an external bevel incision was made along the bleeding spots at a 45° angle [Figure 2].

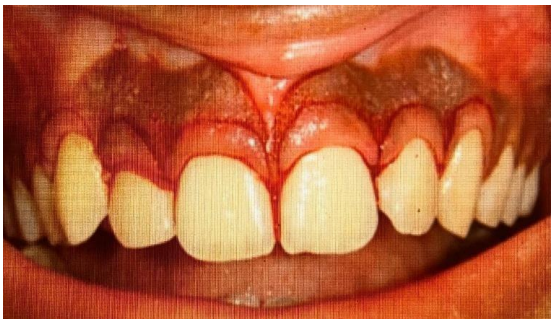

Fig 2- incision given

Gingival depigmentation was performed using a No. 11 bard Parker blade and a high speed hand piece with a diamond bur after the gingivectomy process was finished to an aesthetically desirable degree [Figure 3]. During the surgery, local hemostatic medications were employed to control bleeding.

Fig 3- Post operative site just after Depigmentation

Saline irrigation was applied tothe exposed surface.

The bur was used to apply light feathers to the gingival surface. Brushing strokes in a constant motion. Care was taken to see that the epithelial layer along with remnants of the pigment layer was removed [Figure 4].

Fig 4- Thin layer of connective tissue removed

The surgical wound was protected by a periodontal dressing [Figure 5].

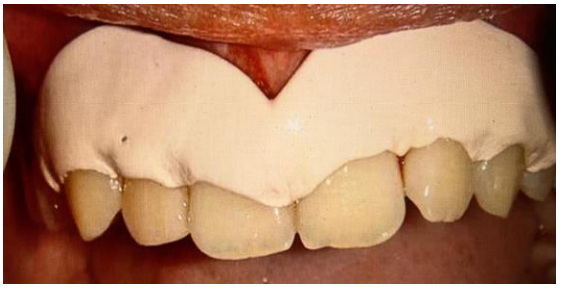

Fig 5- Periodontal dressing on the surgical area

Post-operative instructions were given and the patient was prescribed with antibiotics (amoxicillin 500 mg, thrice daily for 5 days) and analgesics (ibuprofen 400 mg, thrice daily for 3 days). The patient was advised to use chlorhexidine mouth.

Wash (clohex 0.2%; Dr. Reddy's Lab, Hyderabad, India) for 2 weeks post-operatively to aid in plaque control. Patient was reviewed after 2 weeks, the surgical area revealed satisfactory healing and pigmentation was absent on the newly formed epithelium [Figure 6].

Fig 6- 15 days post operative picture.

After three months of therapy, the gingival appearance was good and the outcomes were extremely appealing [Figure 7].

DISCUSSION

Patients are frequently forced to seek cosmetic treatment due to pigmented gingival tissue. The oral mucosa's pigmentation varies in both intensity and distribution, not just between races, as well vary within the same mouth and between persons of the same race. [11] Although the degree of physiologic pigmentation is somewhat influenced by mechanical, chemical, and physical stimuli, it is most likely genetically determined. [5,12] The amount of pigment-containing cells, the thickness of the keratinized layer, and the degree of vascularization all affect gingiva's typical hue. Melanin pigmentation is predominantly induced by melanin deposition by active melanocytes located mainly in the basal layer of the oral epithelium. For aesthetic purposes, pigmentations can be eliminated. For this purpose, a number of therapy techniques have been employed. The method that should be used to depigment the gingiva is depending on the patient's financial situation, the operator's experience, and personal preferences.

Significant edema and increased soft-tissue damage are negative effects of cryosurgery. Long-term freezing accelerates tissue deterioration, although depth control is challenging and the ideal freezing time is unknown due to the lack of a tactile effect. [13] Another option is lasers, but these are costly, need complex equipment, and take up a lot of room. The pigmented regions can also be removed with a free gingival graft. Nevertheless, color matching and an extra surgical site (donor site) are necessary. However, these therapeutic approaches are not commonly utilized or approved.

More skill is needed for electrosurgery than for scalpel surgery. Heat buildup and undesired tissue deterioration are caused by prolonged or repetitive current application to tissue. Given the equipment limitations that may not always be present in clinics, the scalpel surgical method is strongly advised. [11] Scalpel wounds are known to heal more quickly than those caused by othermethods.

However, scalpel surgery may result in uncomfortable bleeding both during and after the procedure, and periodontal dressings must be applied to the exposed gingival tissue for seven to ten days. [11] There have been reports of gingival repigmentation following surgery. The activity and migration of melanocytic cells from nearby regions have been linked to repigmentation, which is described as spontaneous.

CONCLUSION

For many individuals, gingival hyperpigmentation and excessive gingival show are serious problems. While there are now a number of methods in use, the scalpel method is still the most commonly used. There may be reduced discomfort following surgery with lasers and cryosurgery. However, clinical knowledge and patient affordability should be taken into consideration when selecting a procedure. Therefore, we draw the conclusion that

scalpel surgery for depigmentation of hyperpigmented gingiva is straightforward, inexpensive, and, most importantly, less painful and visually pleasing for the patient.

REFERENCES

1. Liebart MF, Fouque-Deruelle C, Santini A, Dillier FL, Monnet-Corti V, Glise JM, et al. Smile line and periodontium visibility. Periodontol 2000;1:17-25.
2. Granstein RD, Sober AJ. Drug- and heavy metal – Induced hyperpigmentation. J Am Acad Dermatol 1981;5:1-18.
3. Coslet JG, Vanarsdall R, Weisgold A. Diagnosis and classification of delayed passive eruption of the dentogingival junction in the adult. Alpha Omegan 1977;70:24-8.
4. Hürzeler MB, Weng D. Functional and esthetic outcome enhancement of periodontal surgery by application of plastic surgery principles. Int J Periodontics Restorative Dent 1999; 19:36-43.
5. Dummett CO. Oral pigmentation. First symposium of oral pigmentation. J Periodontol. 1960; 31:356–60.
6. Page LR, Corio RL, Crawford BE, Giansanti JS, Weathers DR. The oral melanotic macule. Oral Surg Oral Med Oral Pathol 1977; 44:219-26.
7. Trelles MA, Verkruysse W, Seguí JM, Udaeta A. Treatment of melanotic spots in the gingiva by argon laser. J Oral Maxillofac Surg 1993;51:759-61.
8. Prinz H. Pigmentation of the oral mucous membrane. Dent Cosm 1932;72:554-61.
9. Ishikawa I, Aoki A, Takasaki AA. Potential applications of Erbium:YAG laser in periodontics. J Periodontal Res 2004;39:275-85.
10. Kasagani SK, Nutalapati R, Mutthineni RB. Esthetic depigmentation of anterior gingiva. A case series. N Y State Dent J 2012;78:26-31.
11. Prasad SS, Agarwal N, Reddy NR. Gingival depigmentation: A case report. People J Sci Res 2010;3:27-9.
12. Çiçek Y, Ertaş U. The normal and pathological pigmentation of oral mucous membrane: A review. J Contemp Dent Pract 2003;4:76-86.
13. Almas K, Sadig W. Surgical treatment of melanin-pigmented gingiva: An esthetic approach. Indian J Dent Res 2002;13:70-3

Esthetic and Functional Crown Lengthening Surgery : A Case Report

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Abstract

Introduction: Crown lengthening procedure is utilized to increase the clinical length of teeth for restorative or esthetic purposes. Surgical crown lengthening involves increasing the supragingival tooth structure of teeth by either apically positioning the gingival margin, removal of supporting bone or both [1]. The major goal of crown lengthening involves increasing tooth structure, establishing and maintaining biologic width around teeth as well as maintaining adequate keratinized tissue around a tooth [1]. In establishing biologic width the goal is to allow 3mm between gingival margin and alveolar bone. These dimensions have been found by multiple studies to allow adequate room to prevent biologic width impingement [1- 4,6]. Gargulio and colleagues measured the Biologic width in cadavers by studying the Dento-gingival complex they concluded that the epithelial attachment measured on average .97mm, while the connective tissue attachment measure was 1.07mm and the sulcus was .69mm [5].

Biologic width is a combination of the junctional epithelium and connective tissue and measures an average of 2.04mm when combined with the sulcus depth, the measurement of space required is 2.73mm between gingival margin and alveolar bone crest [5,6]. From measurements from Gargulio, it was found that while the connective tissue attachment was the most constant factor and was usually about 1.07mm, epithelial attachment was the most variable part of the dento-gingival complex measurement [5]. Restorations placed into the biologic width can result in symptoms that can range from discomfort in tissue around restorations, bleeding on probing and localized gingival hyperplasia to gingival recession, attachment loss and bone loss [7]. In assessing clinical signs of biologic width violation in patients, they include bleeding on probing, chronic localized gingival inflammation, gingival recession, pocket formation around the restorations, alveolar bone loss and gingival hyperplasia. To prevent these symptoms the use of Crown lengthening is essential to correct the violation. Indications for Crown lengthening procedures include sites with short clinical crowns, subgingival caries or extensive decay, teeth with fracture that require increased tooth structure, when the goal is to create a ferrule effect with restorations, to relocate a margin that was impinging on biologic width, for esthetic reason to match adjacent teeth, for patients with gummy smiles, for uneven gum contours, and to get access for coronal third root perforations [6,7]. When there is inadequate crown to root ratio, or there is nonrestorable caries or fracture, or when there is potential for esthetic compromise and potential for excessive damage to periodontium of adjacent teeth, alternate treatment such as extraction should be considered in order not to cause unstable results [2,7].

Crown lengthening can be either performed for esthetic reasons to correct gummy smiles or gingival overgrowth or for functional and restorative reasons to increase retention of restorations, expose caries, increase tooth structure above alveolar crest and prevent violation of biologic width or for both reasons [1].

INTRODUCTION

Esthetic Crown Lengthening

Esthetic crown lengthening is commonly performed to correct uneven gingival margins, manage cases of altered passive eruption, or treat gingival overgrowth. As teeth erupt, two processes occur: **active eruption**, in which teeth emerge into the mouth, and **passive eruption**, which refers to the apical migration of soft tissue exposing more of the tooth crown [11].

Altered passive eruption occurs when the gingival margin does not migrate apically to the level of the cementoenamel junction (CEJ) during eruption, resulting in the margin being positioned incisal to the CEJ. Several studies have outlined classification systems for altered passive eruption [9–11]. Coslet and colleagues described two major categories:

- **Type I**, characterized by excessive gingival tissue with the margin positioned occlusal or incisal to the CEJ.
- **Type II**, where the amount of gingiva is normal, and the margin is within a normal distance from the CEJ, but all attached gingiva lies on the anatomic crown, placing the mucogingival junction at the CEJ [9–11].

Type I is further divided into subclasses:

- **Type IA**: Excess soft tissue with a normal osseous crest–CEJ distance. Treatment involves gingivectomy alone.
- **Type IB**: Excess tissue with the osseous crest located at the CEJ. Osseous recontouring is required [9,10].

Type II subclasses include:

- **Type IIA**: Reduced keratinized tissue with normal bone crest–CEJ positioning. Managed with an apically repositioned flap without osseous recontouring.
- **Type IIB**: Inadequate keratinized tissue with the osseous crest at the CEJ, requiring both osseous recontouring and apical flap repositioning to achieve esthetic results and preserve biologic width [10].

A diagnosis of altered passive eruption is typically made when the gingival margin is positioned **3 mm or more coronal to the CEJ** of neighboring teeth. It can affect multiple teeth—producing a "gummy smile"—or isolated teeth, creating asymmetrical gingival margins. When identified, esthetic crown lengthening is recommended, with treatment determined by the specific classification.

Case Report: Esthetic Crown Lengthening

A 16 year old girl came to the department of periodontology and implantology Mithila Minority Dental College and hospital Darbhanga with complain of bleeding gums and swellen gums . Clinical photographs demonstrated the improvement in gingival symmetry and the establishment of an esthetically pleasing gingival position in harmony with adjacent teeth, while also preventing biologic width violation. In this case, crown lengthening addressed both esthetic concerns and functional needs (1, 2, 3, and 4).

Figure 1: Initial Picture of patient needing esthetic Crown lengthening

Figure 2: Crown lengthening and co pack dressing has been placed in lower segment

Figure 3: Increase crown length in lower anterior and depigmentation and crown lengthening in first quardrent

Figure 4: Final result after 2 months of treatment

Functional Crown Lengthening

Functional crown lengthening is performed to avoid biologic width violation, establish an adequate ferrule, expose subgingival caries or root fractures, and provide sufficient supragingival tooth structure to improve restoration retention [2]. Ong and colleagues proposed a surgical crown lengthening decision tree that categorizes cases into **Type I** or **Type II**, depending on whether the tooth has adequate (Type I) or inadequate (Type II) keratinized tissue [1].

These categories are further subdivided:

- **Type IA**: Adequate keratinized tissue with the free gingival margin (FGM) or CEJ located **≥2 mm** from the bone crest.
- **Type IB**: Adequate keratinized tissue but with <2 mm between the FGM/CEJ and the bone crest.
- **Type IIA**: Inadequate keratinized tissue with **≥2 mm** between the FGM/CEJ and the bone crest.
- **Type IIB**: Inadequate keratinized tissue with <2 mm between the FGM/CEJ and the bone crest [1].

Based on these classifications, recommended treatments include:

- **Type IA**: Gingivectomy is sufficient when keratinized tissue is adequate and the bone crest is ≥2 mm from the CEJ/FRM.
- **Type IB**: A gingival flap with osseous recontouring is required when there is adequate keratinized tissue but the bone crest is <2 mm from the CEJ.
- **Type IIA**: An apically positioned flap without osseous modification is indicated when keratinized tissue is insufficient but bone height is ≥2 mm from the CEJ.
- **Type IIB**: A combination of osseous resection and an apically positioned flap is recommended when keratinized tissue is inadequate and the bone crest is <2 mm from the CEJ [1].

Figures 1-4 illustrate a functional crown lengthening procedure on lower anterior teeth classified as **Type IB**. In this case, crown lengthening was performed to increase clinical crown height, prevent biologic width violation,

DISCUSSION

The purpose of crown lengthening is to increase the visible portion of a tooth for either esthetic improvement or restorative needs. This can be achieved through procedures such as gingivectomy, gingival flaps, or apically positioned flaps, with or without bone removal (ostectomy), to provide sufficient tooth structure and avoid violating the biologic width. Generally, crown lengthening aims to create about 3 mm of space between the gingival margin and the crest of the bone. The specific technique chosen depends on local anatomical conditions. If the bone crest is too close to the gingival margin, an ostectomy is required to prevent biologic width encroachment. If the bone level is already appropriate, a gingivectomy or an apically positioned flap can be used, with the choice determined by the amount of keratinized gingiva present.

Another nonsurgical alternative to crown lengthening is orthodontic extrusion, which uses orthodontic appliances such as arch wires, elastics, or occlusal plates to pull the tooth coronally. This method can be helpful for teeth with insufficient structure, subgingival decay, biologic width violations, or coronal root fractures. However, while orthodontic extrusion can increase clinical crown height, it is less predictable for achieving ideal esthetic outcomes, as the final gingival margin position may still require surgical correction. For patients with altered passive eruption, surgical crown lengthening remains the recommended approach.

REFERENCES

1. Ong M, Tseng SC, Wang HL. Crown lengthening Revisited. Clinical Advances in Periodontics. 2011; 1: 233-239.

2. Gupta G, Gupta R, Gupta N, et al. Crown lengthening Procedures A Review Article. Journal of Dental and Medical Sciences. 2015; 14: 27-37.

3. Hempton TJ, Dominici JT. Contemporary Crown Lengthening therapy. A Review. Journal of American Dental Association. 2010; 141: 647-655.

4. Sonick M. Esthetic Crown lengthening for Maxillary Anterior teeth. Compendium of Continuing Education. 1997; 18: 807-820.

5. Gargulio AW, Wentz FM, Orban BJ. Dimensions and Relations of the Dento-gingival junction in humans. Journal of Periodontology. 1961; 32: 261-267.

6. Lanning SK, Waldrop TC, Gunsolley JC, et al. Surgical Crown lengthening Evaluation of biologic width. J of Periodontology. 2003; 74: 468-474.

7. Razi MA, Debrath S, Chandra S, et al. Biologic WidthConsidering Periodontium and Restorative Considerations. Int Journal of Contemporary Medical Research. 2019; 6: C5- C11.

8. Bhochhiboy A, Shresta. Biologic width A Review. Journal of Nepalese Prosthodontists Society. 2020; 3: 106-114.

9. Coslet JG, Vermadall R, Weisgold A. Diagnosis and Classification of Delayed Altered passive eruption of Dentogingival junction in Adults. AlphaOmegan. 1977; 70: 24-28.

10. Levine RA, MCGuire M. The Diagnosis and treatment of a gummy smile. Compendium of Continuing Education. 2007; 18: 758-764.

11. Mele M, Felice P, Sharma P, et al. Esthetic treatment of Altered Passive eruption. Periodontology. 2018; 77: 65-83.

12. Rossi R, Benedetti R, Santos-Morales RI. Treatment of Altered Passive Eruption: Periodontal plastic surgery of Dentoalveolar junction. European Journal of Esthetic Dentistry 2008; 3: 212-223.

13. Rossi R, Brunnelli G, Piras V, et al. Altered Passive Eruption and Familial trait. International Journal of Dentistry 2014; Article ID 874092: 1-5.

14. DaSilva VC, De Molon R, MartinsRP, et al. Effects of Orthodontic tooth extrusion produced by different techniques on periodontal tissue: A histologic study on dogs. Archives of Oral Biology 116(2020): 104768.

15. Singh AR, Verma R. Crown lengthening versus Forced Orthodontic Eruption. Orthodontic Journal of Nepal. 2011; 1: 52-55.

16. Bach N, Baylard JF, Orthodontic Extrusion: Periodontal Considerations and Applications. J of Canadian Dental Association. 2004; 70: 775-780

Restoring the Edentulous Mandible with a Conventional Single Complete Denture – A Case Report

Abstract

The concept of the removable partial upper and complete lower denture has been discussed. The requirements for success of such dentures are

1. A meticulously developed lower denture impression,
2. Accurately registered and recorded centric relation at the correct vertical dimension of occlusion, and

3. Carefully formulated occlusion.

The musculature related to the lower denture border, the fundamental needs attendant on an accurate centric relation record, and the method and particulars related to the posterior occlusion have been described.

Keywords : Single complete denture, mandibular complete denture, partially dentulous maxilla,

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INTRODUCTION

Complete denture prosthodontics continues to play a vital role in restoring oral function in elderly patients.

A single complete denture opposing natural or partially dentulous teeth requires careful clinical and laboratory procedures to achieve comfort, stability, and esthetics.

This report presents the rehabilitation of a completely edentulous mandibular arch opposing a partially dentulous maxillary arch in a 75-year-old patient, using conventional techniques.

some of his natural teeth in the others is not uncommon. Neither is it uncommon to find that the successful complete denture for such a patient is often very difficult and on occasions virtually impossible1.

There are two reasons for this difficulty. The first is related to firmness and rigidity with which the natural teeth are retained in the bone and the magnitude of the force they can resist or deliver n without discomfort or displacement. This force has been recorded as high as 198 lb on a single molar teeth. This is in sharp contrast with the force which a complete denture,resting simply on the delicate mucosa of the ridge ,can resist or deliver. This force has been established as being a maximum staticloadof26lb2.

The second reason is related to the occlusal form of the remaining natural teeth, which will of necessity dictate the occlusal form of the denture. The natural teeth may be overerupted or tilted and their cusps high and sharp. As a result ,occlusion and articulation will involve contacting of the inclined planes of the cusps in such a way that the denture will continually be thrust or dragged horizontally on the ridge2.

To overcome these problems, two things are necessary. First, full use must be made of every factor which favours success, and no minor error or imperfection which might perhaps have been tolerated in conventional complete denture construction should be accepted. Second , the forces to which the denture is subject must be reduced as much as possible by appropriate preparation or restoration of the remaining natural teeth so as to provide an acceptable occluding surface.

CASE REPORT

Patient Information

A 75-year-old male patient reported to the Department of Prosthodontics with a chief complaint of difficulty in chewing due to missing lower teeth. The medical history revealed controlled hypertension with no other systemic illness.

Clinical Examination

Intraoral examination revealed a partially dentulous maxillary arch with remaining teeth 13, 14, 15, 16,17 and23, 24,25,26,27 and having removable partial denture wrt 12,11,21,22 while the mandibular arch was completely edentulous with a moderately resorbed residual ridge. The soft tissues were firm and healthy, and salivary flow was adequate. The inter-arch space was found to be sufficient for prosthetic rehabilitation.(Figure 1)

Treatment Plan

A conventional mandibular complete denture was planned to restore function and esthetics , opposing the existing maxillary teeth. The treatment aimed to re-establish comfort and masticatory efficiency through accurate clinical and laboratory procedures.

Clinical Procedure

A primary impression of the mandibular arch was made using impression compound

in a stock edentulous tray. The impression was poured in dental plaster, and a custom tray was fabricated with self-cure acrylic resin, ensuring uniform spacing for the impression material. Border molding was carried out with green stick compound in segments to capture the functional sulcus depth and muscular movements.(Figure 2) The final impression was made with zinc oxide eugenol paste to record fine tissue details and achieve optimal extension and adaptation. The master cast was poured in dental stone.

Record bases and wax occlusal rims were prepared on the master cast. The vertical dimension of rest and occlusion was determined clinically by observing facial appearance, phonetics, and patient comfort.(Figure 3) The centric relation was recorded using the nick-and-notch method, and the casts were mounted on a mean-value articulator for further procedures. Trial denture arrangement was done, and the try-in was evaluated for esthetics, phonetics, and vertical dimension. Minor adjustments were made to harmonize with the opposing maxillary natural teeth, and the patient expressed satisfaction with the appearance.(Figure 4)

The trial denture was processed in heat-cured acrylic resin using the conventional compression molding technique. Following deflasking, the denture was finished, polished, and disinfected before insertion. During insertion, retention and stability were checked, and pressure-indicating paste was used to detect and relieve any pressure areas.(Figure 5,6 and 7) aThe patient was given detailed post-insertion instructions, including proper cleaning, removal at night, and gradual adaptation to the new prosthesis. Follow-up visits were scheduled at 24 hours, one week, and one month.

Figure 1: Pre-op intraoral photograph

Figure 2 : Border moulding and final impression

Figure 3 : Bite registration

Figure 4 : Try- in

Figure 5: Denture insertion (lateral view)

Figure 6: Denture insertion (frontal view)

Figure 7 : Post – op intraoral photograph

DISCUSSION

The rehabilitation of an edentulous mandibular arch opposing natural or partially dentulous teeth requires meticulous attention to impression accuracy, proper determination of vertical dimension, and patient education. In elderly patients, maintaining tissue health and providing adequate patient instructions are crucial for long-term success. This case demonstrates that conventional clinical procedures, when carefully executed, can yield satisfactory results even in complex situations.

CONCLUSION

A conventional mandibular complete denture can successfully restore oral function and esthetics in an elderly patient with an edentulous mandible opposing a partially dentulous maxilla. Adherence to fundamental prosthodontic principles and patient cooperation ensures a stable, comfortable, and esthetic outcome.

REFERENCES

1. Sharry JJ. Complete Denture Prosthodontics. 3rd Ed. New York: McGraw-Hill; 1974; 310-311

2. Anderson, R. Storer . Immediate and Replacements Dentures, Blackwell Scientific Publications, Oxford, 1966; 4

3. Ellinger CW., Jack H. Rayson, Davis Henderson. Single complete denture. J Prosthet Dent , 1971;26(1):4-10

4. French FA. The problem of building satisfactory dentures. J Prosthet Dent, 1954; 4: 769-81.

5. Alex Koper. The maxillary complete denture opposing natural teeth : problems and some solutions. J Prosthet Dent1987; 57(6):704-7..

6. Ohkube C., Kurtz K .S., Suzuki Y., Hanatani S.,AbeM., Hosoi T. comparative study of maxillary complete dentures constructed of metal base and metal structure framework. Journal of oral rehabilitation, 2001;28: 1 49-56.

7. Schneider RL,Stokes JL,Laduke D. Design and fabrication technique for metal palates in maxillary complete dentures. J Dent Technol.2000; 17(7):8-11.

8. Schmizu H, Tsue F , Obukuro M , Kido H, Takahashi Y, OhmuroH. Fracture strength of metal base complete maxillary dentures with a newly designed metal framework .Int Chin J Dent.2005;5: 35-8.

9. Marcaubeanu C, Goguba L, Jivanescu A ,Demjan E, Bratu D. Titanium complete denture base in a patient with heavy bruxism : a clinical report .Journal of Experimental Medical and Surgical Research. 2008; 3: 96-9

MALOCCLUSION- THE TWO PHASE TREATMENT

Abstract

Class II Division 1 malocclusion is one of the most frequently encountered orthodontic problems, often requiring early intervention for optimal skeletal correction. A wide range of functional/orthopedic appliances is available for the correction of Class II skeletal and occlusal disharmonies (eg, Bionator, FR-2 fixed and removable Herbst appliances). Among these, the Twin-block originally developed by William J. Clark of Fife, Scotland, has gained increasing popularity during the last decade. The appliance consists of maxillary and mandibular acrylic plates with bite blocks that posture the mandible forward on closure, and it is indicated for the correction of Class II malocclusions characterized in part by mandibular skeletal retrusion.

This specific malocclusion highlights a two-phase treatment protocol combining functional orthopaedics and fixed mechanotherapy for comprehensive correction. Phase I employed Dr. William Clark's Twin Block appliance, a patient-friendly functional device designed to stimulate mandibular growth and correct sagittal discrepancies in growing individuals. Compared to other myofunctional appliances such as the Activator, Bionator, and Frankel, the Twin Block offers advantages including improved comfort, ease of speech and mastication, and the option for cementation in cases with compliance limitations.

Keywords- Class II Divsiion I, Twin Block, Two Phase Treatment, Myofunctional Appliance

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INTRODUCTION

To establish the optimum course of therapy and when to implement it, a precise diagnosis of the skeletal and dental components of a particular malocclusion is required. Different skeletal and dental configurations can result from class II malocclusions. The anteroposterior posture of the jaw is deficient in the majority of Class II individuals. Class II disorders can be managed in a number of ways, and functional appliances have been utilised for many years to treat Class II Division 1 malocclusions. Skeletal imbalances can now be improved with a variety of functional appliance.

The anticipated results of these functional appliances include altered maxillary growth, potential improvement in mandibular growth and position, and altered dental and muscle interactions.[1] Correcting or hiding the skeletal disparity is often the goal of treatment for Class II malocclusions. Numerous retrospective investigations have found that functional appliances, whether fixed or removable, have an impact on mandibular growth. Large inter- patient variation and small mean changes may mean that the differences in response may be more attributable to study design than treatment. Furthermore, any dentofacial alteration would have happened regardless of therapy and could be the result of natural growth [2]

The main dentoalveolar changes brought about by functional appliance therapy included mesial movement of the lower buccal segments and proclination of the lower labial segments, as well as distalization of the upper buccal teeth and retroclination of the upper labial segments[3].

The primary goal of therapy with functional appliances like the Twin-block is to stimulate greater growth at the condylar cartilage in order to cause more mandibular lengthening. It has been demonstrated that the effectiveness of functional treatment of mandibular growth deficiencies strongly depends on the biological responsiveness of the condylar cartilage, which in turn depends on the growth rate of the mandible.[4]

DIAGNOSIS AND TREATMENT PLAN

A 11-year-old male patient presented with the chief complaint of forwardly placed teeth in the upper front tooth region and inability to close the lip

On corroborating clinical findings and diagnostic records, intraorally it was observed that he had Class II molar relation bilaterally. Extraorally he had incompetent lips and nonconsonant smile and he had a convex facial profile, protruded lips with lip trap present. Overjet of 13mm and overbite of 8 mm with no gross facial asymmetry was detected (Fig 1 & Fig 2).

OPG (Fig 3) revealed erupting canines, 2nd premolars in upper and lower arch and retained 2nd deciduous molars in both the arches and deciduous canines in upper arch. Lateral Cephalogram (Fig 4) indicates Class II skeletal base and retrognathic mandible with Proclined and protruded upper and retruded and retroclined lower anteriors with patient having a horizontal growth pattern. Treatment plan was a Two phase treatment plan: as patient has skeletal and dental class II relationship in growing phase.

- Phase 1- Growth modification using myofunctional appliance therapy (twin block) incorporated with jackscrew for slow maxillary expansion simultaneously

- Phase 2- Fixed orthodontic mechanotherapy for final detailing of occlusion.

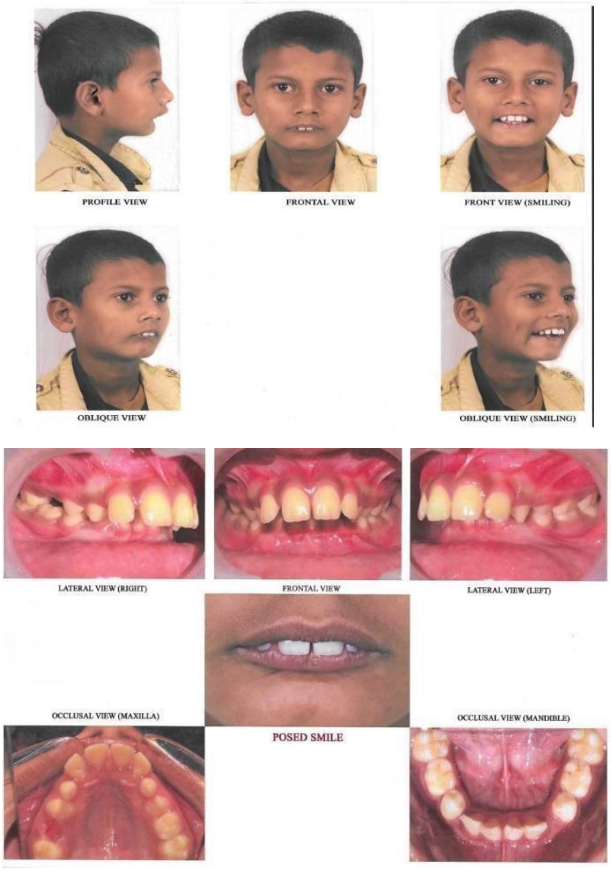
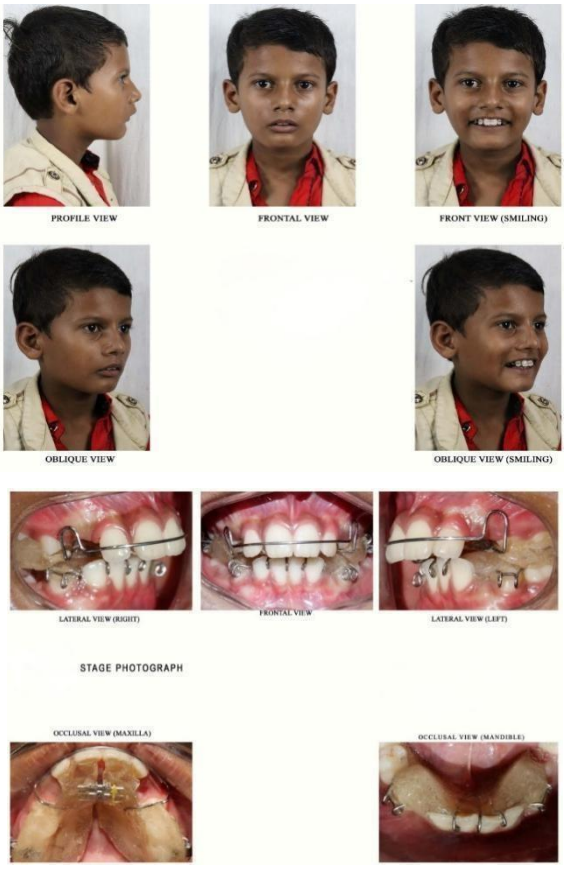


Fig 1 & 2 - Extra & IntraOral Photographs

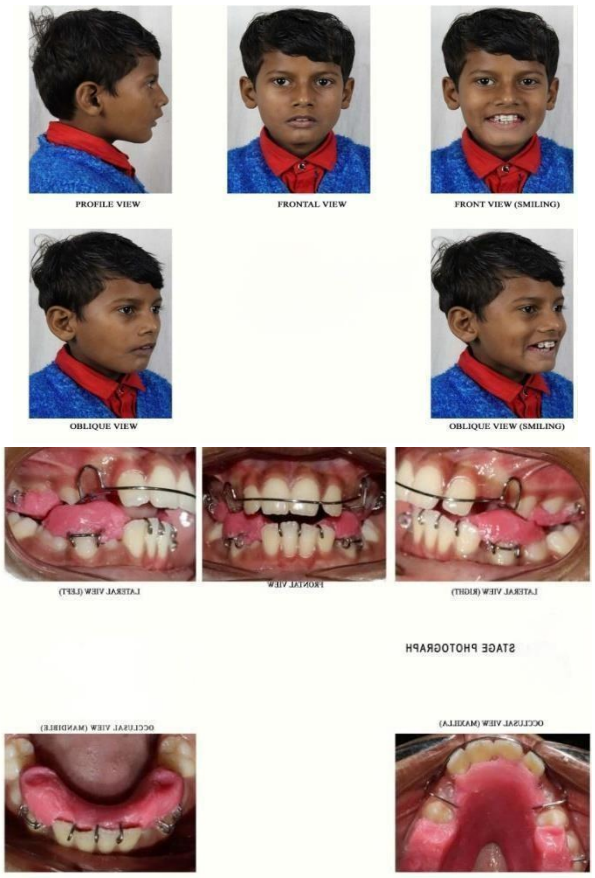
Fig 3. OPG reveals erupting canines and 2nd premolars in upper and lower arch and retained 2nd deciduous molars and canines in Maxillary Arch

Fig 4. Lateral Cephalogram indicated Class II skeletal Base and retrognathic mandible with proclined and protruded upper and retruded and retroclined lower incisor

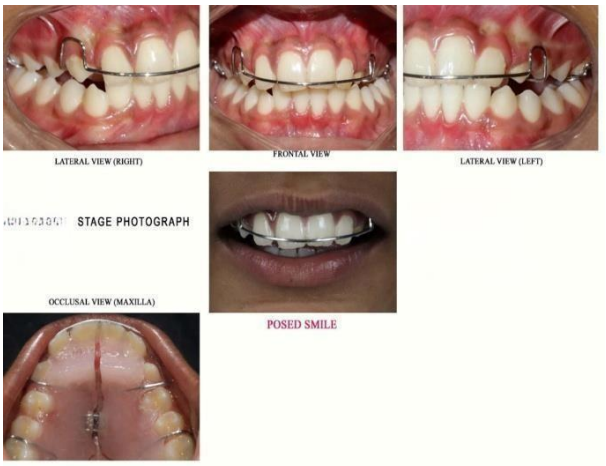
Stage Treatment Intra & Extra Oral Photographs



STAGE 1 – At the time of Twin Block Delivery



Stage 2- At the time of 4.5 months of wearing the appliance



Stage 3 – At the completion of Phase I (11 months)

Radiographs at completion of Phase I/ Phase II

COMPARATIVE CEPHALO-METRIC ANALYSIS

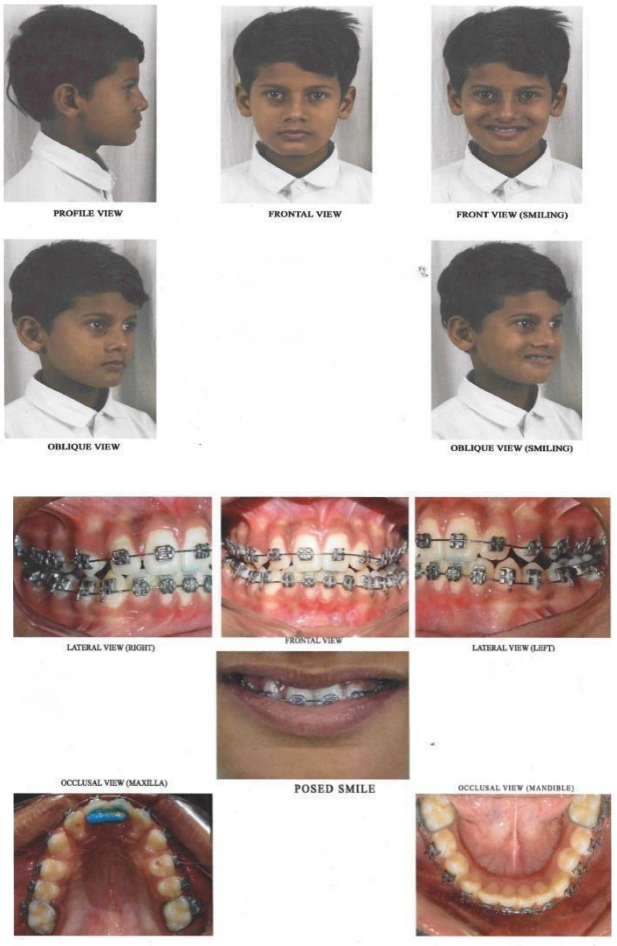
SAGGITAL SKELETAL RELA-TIONSHIP	PRE-TREAT-MENT	POST-TREAT-MENT
SNA	81^0	83^0
SNB	75^0	81^0
ANB	6^0	2^0
WITS AP-PRAISAL	3mm	0mm
DENTAL BASE RE-LATION-SHIP	PRE-TREAT-MENT	POST-TREAT-MENT
UI- NA	5mm/37^0	5mm/18^0
LI-NB	0mm/18^0	0mm/20^0
UI-SN PLANE	118^0	115^0
LI- MPA	99^0	94^0

DENTAL RELATION SHIP	PRE-TREATM ENT	POST-TREATM ENT
INTER INCIAL ANGLE	120^0	130^0
LI-APOG LINE	3mm	0mm
OVERJET	13mm	2mm
OVERBITE	8mm	2mm

VERTICAL SKELETAL RELATION SHIP	PRE-TREATM ENT	POST-TREATM ENT
MAXILLAR Y-MANDIBUL AR PALNE ANGLE	25^0	23^0
SN PLANE-MANDIBUL AR PLANE	23^0	23^0
ANTERIOR FACIAL HEIGHT	89mm	
POSTERIOR FACIAL HEIGHT	64mm	
JARABAK RATIO	71%	77%

SOFT TISSUE ANALYSIS	PRE-TREATMENT	POST-TREATMENT
LOWER LIP TO RICKETS E-PLANE	-2mm	-1mm
NASOLABIAL ANGLE	100^0	100^0

PHASE-2 OF TREATMENT



DISCUSSION

Class II malocclusions brought on by a retrognathic mandible are treated with functional appliances. Although it is still unclear to what degree these appliances cause a clinically relevant increase in growth, a number of clinical trials and systematic reviews have shown that their use results in positive skeletal and dentoalveolar alterations In cases of severe skeletal Class II division 1 malocclusion, early treatment of maxillary proclination may help lower the risk of harm to prominent maxillary incisors and enhance adolescent facial aesthetics.[5] Dental overjet, molar disparities, and the degree of malocclusion were all effectively decreased by early intervention using a Twin-block appliance. Dental and skeletal changes were combined to achieve this. Early intervention with a Twin-block device successfully reduced dental overjet, molar discrepancies, and the degree of malocclusion. This was accomplished by combining bone and dental modifications.[6]

REFERENCES

1. Jena AK, Duggal R, Parkash H: Skeletal and dentoalveolar effects of twin-block and bionator appliances in the treatment of class II malocclusion: a comparative study. Am J Orthod Dentofacial Orthop. 2006, 130:594 602. 10.1016/j.ajodo.2005.02.025
2. Illing HM, Morris DO, Lee RT: A prospective evaluation of bass, bionator and twin block appliances.

Part I the hard tissues. Eur J Orthod. 1998, 20:501-16. 10.1093/ejo/20.5.501

3. Lund DI, Sandler PJ: The effects of twin blocks: a prospective controlled study . Am J Orthod Dentofacial Orthop. 1998, 113:104-10. 10.1016/S0889-5406(98)70282-3
4. Baccetti T, Franchi L, Toth LR, McNamara JA Jr: Treatment timing for twin-block therapy. Am J Orthod Dentofacial Orthop. 2000, 118:159-70. 10.1067/mod.2000.105571
5. Khan MI, Neela PK, Unnisa N, Jaiswal AK, Ahmed N, Purkayastha A. Dentoskeletal effects of Twin Block appliance in patients with Class II malocclusion. Med Pharm Rep. 2022 Apr;95(2):191-196. doi: 10.15386/mpr-1989. Epub 2022 Apr 28. PMID: 35721032; PMCID: PMC9176299.
6. Kevin O'Brien, Jean Wright, Frances Conboy, YeWeng Sanjie, Nicky Mandall, Stephen Chadwick, Ivan Connolly, Paul Cook, David Birnie, Mark Hammond, Nigel Harradine, David Lewis, Cathy McDade, Laura Mitchell, Alison Murray, Julian O'Neill, Mike Read, Stephen Robinson, Dai Roberts-Harry, Jonathan Sandler, Ian Shaw, Effectiveness of early orthodontic treatment with the twin-block appliance: A multicenter, randomized, controlled trial. Part 1: Dental and skeletal effects, American Journal of Orthodontics and Dentofacial Orthopedics, Volume 124, Issue 3, 2003, Pages 234-243, ISSN 0889-5406.

Modern Approaches to Preserving and Restoring Endodontically Treated Teeth through Digital and Conservative Techniques

Abstract

Endodontically treated teeth (ETT) are structurally compromised and prone to fracture due to loss of tooth structure, altered proprioception, and dehydration of dentin. The current pattern in restorative endodontics emphasizes preservation of remaining dental tissue through conservative access, biomimetic materials, and adhesive dentistry. Simultaneously, the integration of digital workflows such as intraoral scanning, CAD/CAM milling, and 3D printing has transformed postendodontic restoration design and fabrication. This article blends modern evidence-based strategies and combines conservative principles with digital technologies to enhance the longevity, function, and esthetics of ETT while minimizing biological cost.

Keyword: CAD/CAM, Endodontically Treated Teeth, Adhesive Dentistry, Tooth preservation

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INTRODUCTION

In earlier times, dentistry frequently required considerable tooth preparation and surgical procedures. But with the introduction of minimally invasive dentistry (MID), which emphasizes early disease identification, preventive measures and conservative treatments that optimize tooth preservation has been revolutionized clinical practice [1].

Endodontically treated teeth (ETT) often present a restorative challenge due to the loss of structural integrity resulting from caries, access cavity preparation and mechanical instrumentation. Traditionally, full-coverage crowns and metallic posts were employed to reinforce these teeth, but such approaches frequently demanded excessive removal of sound dentin predisposing the tooth to unfavorable fracture patterns. In recent years, an ultimate shift has occurred toward tooth structure preservation and biomimetic restoration emphasizing adhesion and conservation rather than replacement. Advances in adhesive dentistry and restorative materials now allow clinicians to restore ETT with minimal intervention while maintaining functional and esthetic integrity.

In endodontics, the development of motor devices and instrumentation procedures together with the support of three-dimensional assessment of tooth anatomy is allowing clinicians to work in more secure conditions with improved outcome predictability. All of these advancements are aimed at achieving minimally invasive access cavities [2–5].

The goal of minimally invasive endodontics (MIE) is to perform endodontic procedures with the least amount of tooth structural loss possible. The primary idea is to thoroughly clean, shape, and fill the root canal systems after disinfecting the pulp chamber, all without compromising a significant amount of dentin and occlusal enamel in the crown and roots. Numerous studies have demonstrated that the quality of post-endodontic restorations has a higher risk of crown and root fractures are the main factors influencing the long-term survival of endodontically treated teeth

Minimally Invasive Access for ETT

The goal of conservative access cavity design is to maintain biomechanical strength by protecting pericervical dentin and residual tooth structure. The idea that teeth with roots are "brittle" may be exaggerated, according to a classic review which emphasized that the main risk is structural loss rather than moisture loss [8]. MID is consistent with the wider clinical trend toward less stressful, patient-centered therapies that improve long-term prognosis and patient satisfaction.

Key elements of minimally invasive access include:

- Using magnification (microscopes/loupes) and enhanced illumination to locate canals with smaller access openings.
- Planning access via CBCT and guided access templates to reduce unnecessary dentin removal.

- Preserving the pulp-chamber roof, marginal ridges, and pericervical dentin where feasible.
- Avoiding full-crown preparation unless absolutely necessary; favoring onlays, endocrowns, and overlays when sufficient structure remains.

Clinical evidence suggests that preserving more tooth structure correlates with better survival of ETT. Furthermore, when access is planned digitally and executed conservatively, it facilitates better restorative outcomes as the remaining tooth is stronger and better able to support adhesive restorations.

Restorative Techniques for ETT

Endocrowns, bonded onlays and fibre posts

Endocrowns on the other hand combine the intraradicular post core and crown into a single unit. The pulp chamber is utilized to increase stability by improving retention through a larger surface area for adhesion [9]. Endocrowns or onlays are mainly monoblock ceramic restorations that use the pulp chamber for micromechanical retention. It is a conservative approach alternative to post and core crowns in molars and premolars with adequate pulp chamber depth and adequate remaining tooth wall structure. systemic review and clinical trials also suggest high survival rates for endocrowns.

Endocrowns are becoming the preferred method for molars and premolars particularly when combined with digital CAD/CAM workflows: Success rates of 94–100% were reported in one investigation that examined 99 endocrown restorations with a mean follow-up of 45 months [10].

Fiber-reinforced composite or short fiber-reinforced composite (SFRC) is mainly used for direct restorations as core material. These materials are efficient in absorbing stress and can be bonded better with the remaining tooth structure. SFRC has a better stress distribution pattern similar to dentin and can serve as a dentin replacement layer beneath the conventional composite. It is because the embedded fibers act as crack resistant and also mimic the way collagen fibrils limit crack propagation in natural dentin. This composite base under conventional composite provides a biomimetic gradient of stiffness with a strong dentin substitute below and an aesthetic enamel replacement above.

Adhesive restorations such as endocrowns, bonded onlays, overlays or fiber-post retained cores are modern choices when coronal structure is significantly weakened. While posts are not always required (and may even weaken the tooth if excessive dentin removal occurs), contemporary adhesive protocols combined with fiber posts or endocrowns offer favorable biomechanics, according to a recent review on the use of fiber posts. With the recent development of adhesive systems and biomimetic materials, direct restoration can be used for many posterior ETT with limited tooth loss. These are conservative, cost-effective and reparable. Nowadays fiber posts are preferred over metal as they have an elastic module i.e. closure to dentin. However, these posts do not

strengthen the root but they mainly provide retention for core material and restorations.

Key restorative guidelines for ETT:

- Even with minimally invasive techniques try to maintain a ferrule of 1-2 mm.
- When there is very little coronal tooth structure left choose indirect adhesive restorations.
- Appropriate bonding procedures (etching, primers and 10-MDP for zirconia) and digital occlusion and margin verification in digital workflows will assure precise fit.

Direct vs Indirect restorations

Direct (composite/amalgam) and indirect (onlay, crown) restorations of ETT with ≥3 years of observation were compared in a systematic review and meta-analysis; indirect restorations demonstrated higher 5–10 year survival (OR 0.28 and 0.20, respectively) than direct restorations. However, they found no discernible difference in endodontic success or short-term survival and the quality of the evidence was low to moderate. This implies that complete crowns or indirect adhesive restorations may provide a longer lifespan for severely damaged ETT [8].

Digital Workflow in the Management of ETT

Intraoral scanning and CAD/CAM restorations

Intraoral scanners (IOS), CAD/CAM manufacturing and digital design are examples of digital workflows that are increasingly used in fixed prosthodontics including indirect restorations of ETT. Despite the paucity of high-quality RCTs, a systematic assessment of "complete digital workflows" in fixed prosthodontics revealed evidence of increased time efficiency and equivalent precision to traditional procedures [11] .

Digital workflows for ETT have the following advantages:

- Conservative preparations are possible because minimally invasive onlays and endocrowns rather than complete crowns can be fabricated because of computerized design.
- Improved restoration precision as a result of precise digital impressions and fit.
- Less chair time and fewer visits (particularly crucial for young or nervous patients).

There are however certain drawbacks: there is a dearth of long-term survival data, particularly in ETT and the quality of the evidence is still moderate to low.

Guided access and endodontic-restorative integration

Another dimension of digital workflow concerns guided access for endodontic treatment and subsequent restoration. Guided endodontics (using CBCT + IOS + 3D printed guides) supports minimally invasive access with less tooth structure

removal reduced risk of perforation and improved precision. Although direct systematic reviews on ETT restoring via guided access are lacking this approach aligns with the conservative philosophy explored in the next section (8, 9).

Integration of digital & conservative philosophy

The combination of digital workflows and conservative restorative access is essential: guided access allows for minimal tooth extraction; CAD/CAM fabrication of restorations (onlays, endocrowns) permits fit and minimally invasive retention and digital impression/scan enables the restorative design to respect remaining structure and also replaces the traditional impression material For instance, intraoral scanning and CAD/CAM were employed in a single sitting in a case involving a young patient, with a focus on aesthetic restoration and the preservation of the remaining tooth [12]. This scanning enables the clinician or technician to evaluate occlusion, contact points, internal fit and marginal integrity even before the restoration is fabricated. It minimizes chairside time i.e. time required for adjustments and ensures precision.

Since it is a digital process one of the major advantages is that the data is can be stored for an indefinite period which enables easy modification and monitoring of changes over time.

From a clinical workflow perspective:

1. (Planning for treatment and pre-restorative care) Plan access and restoration and evaluate the remaining tooth structure using preoperative C

   This planning aids in minimizing unnecessary reduction of tooth structure and ensures the most conservative and effective restorative strategy.

2. To preserve the endodontically treated tooth and restore shape and function, create an adhesive indirect restoration as soon as possible using CAD/CAM.
3. Use proper bonding/adhesion protocols, verify ferrule/retention, and avoid over-preparation.

Discussion

According to the literature, conservative access/restorative methods combined with contemporary digital processes improve the prognosis of ETT. Digital processes increase productivity and accuracy but they must be used carefully. Merely digitizing outdated procedures without maintaining their fundamental integrity may not produce better results. Maintaining tooth strength requires less intrusive access. Evidence suggests that indirect adhesive solutions are preferable to direct restorations particularly when structure is damaged. Integrating digital dentistry into a conservative approach has revolutionized precise and reproducible outcomes. This digital workflow has now enabled clinicians to design, fabricate and deliver restorations with more accuracy than was lagging in with conventional methods.

Lack of long-term (>10 years) clinical data to assess survival and success rate as well as the significant variation across studies concerning tooth type residual tooth structure, restorative materials, and follow-up duration are some of the major obstacles and evidence gaps in digital and conservative strategies for restoring endodontically treated teeth (ETT). Further obstacles to the wider clinical use of guided access and fully digital processes include

cost, equipment investment and clinician learning curves. Additionally, there are no established standards to assess and scientifically define "minimally invasive" operations or to set boundaries for the minimal amount of tooth structure that must remain in order to guarantee predictable long-term results.

Conclusion

For the purpose of accomplishing high-precision restorations that respect the tooth's biomechanics, modern ETT management should place a high priority on minimally invasive access to preserve the remaining tooth structure. Digital workflows including scanning, CAD/CAM and guided access should also be utilized. Adhesive indirect restorations (onlays, endocrowns) performed by digital workflows had a higher medium-term survival rate than direct restorations for teeth with substantial structure loss. To maximize ETT lifetime, clinicians should combine cautious access and digital planning with evidence-based restorative decisions. Longer follow-up and high-quality future research are required to validate these strategies.

Reference

1. Degrange M, Roulet JF. Minimally Invasive Restorations with Bonding. Quintessence Publishing (IL); 1997. 292 p.

2. Gambarini G, Seracchiani M, Piasecki L, Valenti Obino F, Galli M, Di Nardo D, et al. Measurement of torque generated during intracanal instrumentation in vivo. Int Endod J. 2019 May;52(5):737–45.

3. Gambarini G, Di Nardo D, D'Angelo M, Morese A, Seracchiani M, Testarelli L. Potential of Operative Torque in Evaluating NiTi Instruments. J Contemp Dent Pract. 2020 Feb 1;21(2):113.

4. Gambarini G, Piasecki L, Miccoli G, Gaimari G, Di Giorgio R, Di Nardo D, et al. Classification and cyclic fatigue evaluation of new kinematics for endodontic instruments. Aust Endod J. 2019 Aug;45(2):154–62.

5. Oshida Y, Tominaga T. Nickel-Titanium Materials: Biomedical Applications. Walter de Gruyter GmbH & Co KG; 2020. 974 p.

6. Hao J, Liu H, Shen Y. Periapical Lesions and Missed Canals in Endodontically Treated Teeth: A Cone-Beam Computed Tomographic Study of a Chinese Subpopulation. Med Sci Monit. 2023 Jul 4;29:e940533.

7. Tang W, Wu Y, Smales RJ. Identifying and reducing risks for potential fractures in endodontically treated teeth. J Endod. 2010 Apr;36(4):609–17.

8. Shu X, Mai QQ, Blatz M, Price R, Wang XD, Zhao K. Direct and Indirect Restorations for Endodontically Treated Teeth: A Systematic Review and Meta-analysis, IAAD 2017 Consensus Conference Paper. J Adhes Dent. 2018;20(3):183–94.

9. Nasr M, Abd-Elhaliem N. Effect of inlay, onlay, and endocrown restorations on the mode of failure and fracture resistance of endodontically treated maxillary premolar teeth. An in vitro study. Egypt Dent J. 2024 Apr 1;70(2):2031–40.

10. Davidovich E, Shay B, Nuni E,

Mijiritsky E. An Innovative Treatment Approach Using Digital Workflow and CAD-CAM Part 1: The Restoration of Endodontically Treated Molars in Children. Int J Environ Res Public Health [Internet]. 2020 Feb 20;17(4). Available from: http://dx.doi.org/10.3390/ijerph17041364

11. Bernauer SA, Zitzmann NU, Joda T. The Complete Digital Workflow in Fixed Prosthodontics Updated: A Systematic Review. Healthcare (Basel) [Internet]. 2023 Feb 25;11(5). Available from: http://dx.doi.org/10.3390/healthcare11050679

12 Website [Internet]. Available from: Gupta G, Gupta D, Gupta P, Khairwa A, Rana KS. Customized esthetic restoration in endodontically treated young permanent 1 molar [Internet]. IP Indian J Conserv Endod. 2022 [cited 2025 Nov 07];7(2):67-71. Available from: https://doi.org/10.18231/j.ijce.2022.014

A Historical review in the field of Oral & Maxillofacial Surgery

Abstract

The evolution of oral and maxillofacial surgery spans from ancient Egyptian management of mandibular fractures to today's technologically advanced specialty. Early contributions by Greek, Roman, and Arabic physicians established foundational techniques in extractions, infection control, and fracture management. Progress accelerated during the Renaissance with Paré's innovations and later through the development of anaesthesia, implantology, and specialized surgical training in the 19th and 20th centuries. Advances driven by wartime experience further expanded the scope of orthognathic, cleft and craniofacial, TMJ, oncologic, cosmetic, trauma surgery and hair transplant surgery. Modern practice has been transformed by high-speed instrumentation, minimally invasive techniques, 3D imaging, virtual surgical planning, tissue engineering, regenerative medicine, and robotic systems. Emerging technologies, including artificial intelligence, enhance diagnostic accuracy, predictive analytics, and surgical precision. While innovations continue to improve patient outcomes, challenges such as cost, training demands, and material limitations highlight the need for ongoing research to optimize future maxillofacial reconstruction and care.

Keywords: Cleft and craniofacial; Hair transplant; Orthognathic surgery; TMJ

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Introduction

The dental and oral surgical records date back to ancient Egypt around 2700 BC, where papyrus described treatments for mandibular fractures using bandages soaked in honey and egg white. By 1200 BC, Greek priests known as Asclepiads performed tooth extractions and used herbal medicines also.[1] In the 4th century BC, Hippocrates advanced dental practice by extracting mobile teeth, managing abscesses, and stabilizing mandibular fractures using gold wire, although he discouraged bandaging.[2] Roman physician Celsus (25 BC–50 BC) continued Greek practices but warned of the dangers of extraction, advising protective measures to avoid crown fracture and managing abscesses and jaw fractures.[3] After the Roman Empire, Arabic physicians such as Rhazes, Albacasis, and Avicenna significantly expanded oral surgical procedures, including the treatment of infections, fistulae, ranulas, epulis, frenectomies, jaw fractures, and TMJ dislocations. They also emphasized making incisions along skin lines long before Langer described skin tension lines.[4,5]

During the Middle Ages, medicine and surgery became separate fields: medicine was taught at universities, while surgery was practiced by lay surgeons and barber surgeons through apprenticeships. In 1540, the British parliament united these groups and defined their roles, restricting barber surgeons to tooth extractions and forbidding lay surgeons from barbering.[4] In the Renaissance (14th–17th century), the scope of oral and maxillofacial surgery expanded significantly. Ambroise Paré, originally a barber surgeon, became a leading military and hospital surgeon. He improved treatment of jaw fractures, TMJ dislocations, tumors, and gunshot wounds, advocating gentler wound care and introducing ligatures to control bleeding instead of cautery. He also emphasized accuracy in tooth extraction and warned against complications from retained bone fragments.[5] Another key contributor, Johannes Scultetus, was the earliest to describe marsupialization of jaw cysts, a procedure later attributed to Carl Partsch.[6]
A few doctors with dental expertise performed oral surgery in the United States in the 1800s, with Simon P. Hullihen being a notable pioneer. Despite the absence of anesthesia, he performed numerous complex procedures, including cleft lip and palate repairs, cancer surgeries, maxillary sinus treatments, and reconstructive operations, and is credited with performing the first documented orthognathic surgery.[7]
Tooth extraction remained the most common procedure, and significant progress occurred when Boston dentist William Morton discovered the anesthetic properties of ether. On October 16, 1846, Morton and surgeon John

Warren performed the first successful surgery under ether anesthesia at Massachusetts General Hospital, marking a major milestone in modern surgical practice.[8]
James E. Garretson, often regarded as the founder of oral and maxillofacial surgery in the United States, published the first comprehensive textbook defining the scope of the specialty: A Treatise on the Diseases and Surgery of the Mouth, Jaws and Associated Parts, later expanded as a system of oral surgery. A review in Dental Cosmos praised the work for bridging dentistry with medicine and establishing oral surgery as a distinct specialty. Garretson advocated replacing the DDS degree with an MD degree for dental graduates and expanding dental education to include full medical training—a push

that continued into the 20th century.[9] Many early oral surgeons trained in both dentistry and medicine, including Matthew H. Cryer, Truman Brophy, Thomas L. Gilmer, and Chalmers L. Lyons, though most aligned themselves with dental schools and viewed oral surgery as a branch of dentistry.

From the 1800s onward, the scope of oral surgery expanded significantly, largely due to experience gained in treating traumatic injuries during major wars. As Hippocrates noted, war served as a crucial training ground for surgeons, and this was evident during the World Wars and later conflicts such as the Gulf, Iraq, and Afghanistan wars.[10] The surgical skills, anatomical knowledge, improved training programs, and technological advances developed over these periods contributed to major progress in orthognathic surgery, TMJ surgery, nerve repair, craniofacial surgery, oncologic surgery, cosmetic surgery, and implantology, shaping the modern practice of the specialty.

Innovations with the aid of technology

Third molar surgery originally relied on chisels and mallets until the development of powered instruments. Techniques such as the lingual split were introduced, and in 1964 Robert Hall revolutionized surgery with the nitrogen-powered high-speed "Hall drill," enabling easier bone and tooth cutting. Later integration of air turbines allowed electric handpieces to reach surgical speeds above 400,000 RPM.[11] Advances in surgical techniques required better anaesthesia. William Morton's 1846 demonstration of ether anaesthesia marked the beginning of modern surgical anaesthesia. Over time, anaesthesia became its own specialty, but oral and maxillofacial surgeons (OMS) continue to provide safe outpatient anaesthesia, aided by modern monitoring devices like wireless precordial stethoscopes and BIS monitors.[12] The discovery of osseointegration by Per-Ingvar Brånemark led to the first long-lasting titanium dental implants in the 1960s. Since the 1980s, implant technology has improved with better surface designs, varied dimensions, and accessible grafting materials.[13] The approval of recombinant BMP-2 in 2007 advanced bone augmentation procedures. Today, 3-D imaging and surgical navigation are standard for implant planning, with robotic-assisted implant placement emerging as a future direction for enhanced precision.[14]

Craniofacial and orthognathic surgery

Modern craniofacial and orthognathic surgery owes much to two pioneers: Paul Tessier, the father of craniofacial surgery, and Hugo Obwegeser, the father of orthognathic surgery. Tessier advanced treatment of congenital craniofacial anomalies using innovative transcranial and subcranial approaches and bridged multiple specialties, leaving detailed documentation for future surgeons. Obwegeser developed key techniques for repositioning the mandible and maxilla, including the original sagittal split osteotomy and the first successful Le Fort I maxillary mobilization, inspiring widespread adoption of orthognathic surgery in the United States.[15] Distraction osteogenesis, attempted since the 14th century, was first applied to the facial skeleton in 1927, with early contributions from Varaztad Kazanjian. Modern distraction techniques became feasible only after advancements in fixation and device engineering, with major progress led by McCarthy in 1989 and later improvements by Molina and Ortiz-Monasterio.[16]

Technological innovations such as virtual surgical planning, cutting guides, and CT-based planning have greatly improved precision in craniofacial and orthognathic surgeries. In TMJ surgery, OMS specialists

have developed classification systems, prostheses, and minimally invasive techniques. Early failures of Teflon/Proplast prostheses prompted the development of reliable modern joint replacements. Joseph McCain pioneered TMJ arthroscopy, and contemporary practice continues to shift toward minimally invasive approaches.[17]

TMJ disorders

Temporomandibular joint (TMJ) disorders may lead to persistent. discomfort and pain in the muscles surrounding the jaw joint. Oral and maxillofacial surgeons are capable of diagnosing and offering treatment alternatives, which includes both conservative approaches and surgical procedures, to relieve symptoms associated with TMJ

Cleft lip and palate repair

Cleft lip and palate are birth defects that impact the development of the upper lip and the roof of the mouth. Maxillofacial surgeons collaborate within a multidisciplinary team to conduct corrective procedures, assisting both children and adults in enhancing their speech, swallowing, and facial aesthetics.[18]

Facial cosmetic surgery

Oral and maxillofacial surgeons have a deep understanding of facial anatomy and aesthetics, which equips them to carry out cosmetic procedures effectively. They provide services like facial rejuvenation, chin enhancement, and facial sculpting to elevate facial attributes and boost self-esteem.

Facial trauma reconstruction

Treating facial injuries brought on by mishaps, sports-related occurrences, or other traumatic experiences is the specialty of maxillofacial surgeons. They have the expertise to repair fractured facial bones, treat soft tissue injuries, and restore normal function and aesthetics.[19]

Hair transplantation

Hair transplantation has gained significant popularity as a cosmetic procedure. As a relatively emerging area within maxillofacial surgery, various facets of hair transplantation present challenges and controversies. Two widely recognized techniques are follicular unit transplantation (FUT) and follicular unit extraction (FUE). Additionally, hair transplantation has been effectively utilized to address conditions such as alopecia, scars from cleft lip, post-burn or surgical scars, vitiligo, and as a supplementary option in other maxillofacial surgeries.[20]

Minimally invasive techniques

One of the most significant progressions in oral surgery is the transition towards minimally invasive techniques. Conventional surgical practices often necessitated large cuts and inflicted considerable damage to adjacent tissues. Nevertheless, with the advent of new techniques and instruments, oral surgeons can now perform operations through smaller incisions. This method lessens post-operative discomfort, swelling, and recovery duration, resulting in a better experience for patients and a quicker return to their normal routines.

Three-dimensional imaging and guided surgery

3D imaging technology has fundamentally transformed how oral surgeons plan and carry out complex dental procedures. Oral and maxillofacial structures can be precisely and thoroughly imaged in three dimensions using cone-beam computed tomography (CBCT) scans. These scans enable surgeons to visualize anatomical features with greater accuracy, resulting in improved treatment planning and surgical outcomes. Guided surgery, a development stemming from 3D imaging, involves creating a surgical guide customized to the patient's specific anatomy. This guide assists the surgeon in achieving precise implant placement, thereby reducing the margin of error and enhancing the durability of dental implants.

Laser technology

The incorporation of laser technology in oral surgery has marked the beginning of a new era characterized by accuracy and effectiveness. In order to cure gum disease, remove soft tissue lesions, and prepare teeth for restorative work, dental lasers are being used more and more frequently. Because it lowers bleeding, eliminates the need for stitches, and speeds up the healing process, laser dentistry is a very alluring substitute for conventional surgical methods.

Regenerative medicine

Regenerative medicine has revealed considerable promise in the field of oral surgery.
Utilizing the patient's own blood components, techniques such as platelet-rich plasma (PRP) and platelet-rich fibrin (PRF) promote tissue regeneration and improve healing following surgical treatments. These natural and safe methods aid in the regeneration of both bone and soft tissue, making them important tools for implant placement and other reconstructive operations.[21-25]

VSP and 3D Printing

In the field of oral and maxillofacial reconstruction, Virtual Surgical Planning (VSP) has emerged as an invaluable tool, revolutionizing the way surgeon approach complex cases. By utilizing patient-specific imaging data obtained through high-resolution computed tomography (CT) or cone-beam computed tomography (CBCT) scans, VSP allows for a comprehensive understanding of an individual's unique anatomical features.[26] These scans are meticulously processed and transformed into detailed 3D digital models, which not only enhance the visualization of intricate structures such as bones, nerves, and soft tissues but also facilitate a more thorough assessment of deformities or pathologies. Surgeons can simulate various surgical outcomes using these models, enabling them to evaluate different strategies and select the most effective approach before performing the actual procedure. Furthermore, this meticulous planning helps in anticipating potential complications and refining surgical techniques, ultimately leading to improved accuracy, reduced operative time, and enhanced postoperative recovery for patients. The use of VSP thus represents a significant advancement in achieving tailored surgical interventions that align closely with the individual needs of patients. [27]

Tissue Engineering

Tissue engineering offers promising new solutions for regenerating large maxillofacial defects, especially those involving the loss of critical bone.

Advances in 3D printing have enabled the creation of patient-specific bioactive scaffolds that support personalized regenerative treatments.[28] By integrating stem cells, growth factors, and biomaterials, tissue engineering helps recreate a functional microenvironment—particularly important for vascularization and healing. Although stem cell–based therapies show great potential, no clinically established alternatives currently replace microsurgical free tissue transfer, the present gold standard. Nevertheless, emerging approaches, such as the combined use of advanced platelet-rich fibrin with bone allografts, demonstrate accelerated healing and improved regeneration. Despite significant progress, achieving fully functional reconstruction of complex tissues remains a major challenge, requiring ongoing research and technological refinement.[29,30]

Robotic surgery

Robotic surgery in maxillofacial and head-and-neck treatment is still in its early stages, showing promise but facing significant limitations. Current research demonstrates good outcomes for tumor resection regarding morbidity, oncologic control, and functional recovery, yet challenges remain, including higher rates of capsule rupture, long operative times, large drainage needs, and uncertain benefits for HPV-negative patients. Long-term outcomes, cost-effectiveness, and optimal indications still require further study. Future advancements are expected to include specialized instruments, smaller and more flexible systems, haptic feedback, multi-surgeon capability, and improved multiport access. Virtual surgical planning (VSP) is anticipated to enhance precision and efficiency when combined with robotic systems.

Beyond oncology, robotic surgery shows potential in managing obstructive sleep apnea (OSAS), especially for patients intolerant to CPAP, though success is limited due to multifactorial disease influences. Proper patient selection and combination procedures may improve outcomes. However, current robotic systems lack the tactile feedback needed for safe management of maxillofacial fractures and craniofacial asymmetry. Evidence for robotic surgery in cleft lip and palate, lingual thyroid, and salivary stone disease is scarce, requiring larger and more rigorous studies. Additionally, the diversity and complexity of maxillofacial operations demand standardized procedures before robots can be widely adopted. Further development in instrument design, intraoperative navigation, and large-scale clinical research is essential to expand robotic surgery's role in non-malignant craniofacial conditions.[31]

Future Directions

Advancements in digital, additive manufacturing, and tissue-engineering technologies have significantly improved oral and maxillofacial restoration, yet several challenges hinder widespread clinical adoption. Although VPS, CAD/CAM, and 3D-printing technologies enhance diagnostic accuracy and treatment outcomes, their high initial costs, time-intensive workflows, material limitations, and steep learning curves remain major barriers. Complex 3D-printed implants require specialized production facilities, and concerns such as implant rejection, infection, and inadequate biocompatibility highlight the need for improved materials and rigorous clinical trials. Additive manufacturing is further constrained by imaging incompatibilities and the limited printability of certain polymers and metals, emphasizing the need for better materials

and optimized printing parameters.[32] In CAD/CAM dentistry, high expenses, extensive training requirements, and challenges in achieving durable, aesthetic restorations underscore the need for more evidence on long-term material performance. Tissue engineering shows promise but is still limited in reconstructing complex soft tissues and requires greater standardization before routine use. Overall, continued research, innovation, and regulatory development are essential to fully realize the potential of these emerging technologies in maxillofacial reconstruction.[33]

Role of Artificial Intelligence

AI-assisted surgical planning enhances precision in complex oral and maxillofacial procedures by using advanced imaging and analytical tools. These systems provide detailed visualization of the surgical site and offer data-driven recommendations for optimal techniques. Applications include orthognathic surgery, maxillofacial trauma management, oral cancer excision, TMJ surgeries, correction of facial deformities, placement of dental and patient-specific implants, and removal of impacted teeth. By improving surgical accuracy, AI helps reduce complications, speeds up recovery, and supports better overall patient outcomes. [34,35]

Detection of pathologies

AI is improving medical diagnosis by rapidly analyzing X-rays, CT scans, and MRIs to detect abnormalities such as tumors and fractures with high accuracy. In pathology, it aids in identifying subtle early signs of disease, enhancing early detection and treatment. AI exhibits great promise in maxillofacial pathology for accurately identifying disorders such as oral cancer and forecasting how treatment will work. While AI can reduce diagnostic errors and improve consistency, it is meant to support—not replace—clinicians. Continued research and validation are needed to ensure its effectiveness in complex cases.[35,36]

Predictive analytics

AI enhances oral surgery care by using large datasets to predict complications, treatment responses, and long-term outcomes, enabling early intervention and personalized follow-up. It supports clinicians through automated image-based diagnoses, real-time record updates, and detection of drug interactions or prescription errors. With continuous availability, AI tools and apps improve patient safety, streamline clinical workflows, and keep patients better informed throughout their treatment.[37]

Conclusion

The field of oral surgery is constantly progressing, with state-of-the-art advancements enhancing patient treatment and transforming dental procedures. Utilizing minimally invasive methods, 3D imaging, laser technology, and regenerative medicine, oral surgeons now have a wide range of resources to achieve optimal results for their patients. As technology continues to develop, we can anticipate even more extraordinary breakthroughs in oral surgery, which will further influence the future of dental care. Patients can expect procedures to become safer, less invasive, and more efficient, ultimately benefiting their oral health and overall wellness. Oral surgery, a distinct area within dentistry, has undergone considerable changes over the years, with numerous innovations transforming the practice. This article delves into the most recent advancements in

oral surgery that are paving the way for the future of dental care. From advanced technologies to improved methodologies, these innovations provide patients with safer, more effective, and comfortable treatment alternatives while enhancing the results for various dental issues.

References

[1] V. Guerini, A History of Dentistry from the Most Ancient Times until the End of the Eighteenth Century, Lea & Febiger, Philadelphia, 1909.

[2] A. Densham, A review of the progress of dental science and literature from the earliest ages, Proc. Roy. Soc. Med. 2 (1909) 71–98.

[3] F. Adams, The Seven Books of Paulus Aegineta, Sydenham Society, London, 1846.

[4] P.R. Garant, The Long Climb from Dental Surgeons to Doctors of Dental Surgery, Quintessence Publishing Co, Chicago, 2013.

[5] W. Hoffmann-Axhelm, History of Dentistry, Quintessence Publishing Co., Chicago, 1981.

[6] F.R. Packard, Life and Times of Ambroise Pare, Paul B. Hoeber, New York, 1921.

[7] S.R. Aziz, P. Simon, Hullihen and the origin of orthognathic surgery, J. Oral Maxillofac. Surg. 62 (2004) 1303–7.

[8] The future of dentistry, Dent Cosmos 14 (1872) 608–11.

[9] D.H. Robinson, A.H. Toledo, Historical development of modern anesthesia, J. Invest. Surg. 25 (2012) 141–9.

[10] N.L. Rowe, The history of the treatment of maxillo-facial trauma, Ann. R. Coll. Surg. Engl. 49 (1971) 329–49.

[11] Alpert B. The Evolution of Oral and Maxillofacial Surgery Over the Past 100+ Years—With Special Emphasis on the Role of Fluoride and the High-Speed Handpiece. J Oral Maxillofac Surg 2018;76:1611-5.

[12] Morimoto K, Tsutsui Y, Ogura S, et al. Are Wireless Electronic Stethoscopes Useful for Respiratory Rate Monitoring During Intravenous Sedation? J Oral Maxillofac Surg 2018;76:70.e1-7

[13]. Lewin T. Per-Ingvar Branemark, Dental Innovator, Dies at 85. The New York Times. 2014.

[14]. Miller RJ, Bier J. Surgical Navigation in Oral Implantology. Implant Dent 2006;15

[15]. Ghali MG, Srinivasan VM, Jea A, et al. Craniosynostosis surgery: the legacy of Paul Tessier. Neurosurg Focus 2014;36:E17.

[16]. Molina F, Ortiz Monasterio F. Mandibular elongation and remodeling by distraction: a farewell to major osteotomies. Plast Reconstr Surg 1995;96:825-40;41-2.

[17].Lee KC, Eisig SB, Perrino MA. Foreign Body Giant Cell Reaction to a Proplast/Teflon Interpositional Implant: A Case Report and Literature Review. J Oral Maxillofac Surg 2018;76:1719-2.

[18] Sadeghi M. Fracture strength and bending of fiber-reinforced composites and metal frameworks in fixed partial dentures. Frontiers in Dentistry. 99- 104 (2008).

[19]. Perkins BA, Ficociello LH, Silva KH et al. Regression of microalbuminuria in type 1 diabetes. N Engl J Med. 348, 2285-93

[20]. Dua K, et al. A look back at hair restoration through history. Int J Transpl Plast Surg. 2017;1(1):000101.

[21]. Partridge L, Deelen J, Slagboom PE *et al.* Facing up to the global challenges of ageing. *Nature.* 561, 45-56 (2018).

[22]. Coman V, Vodnar DC. Gut microbiota and old age: Modulating factors and interventions for healthy longevity. *Experimental Gerontology.* 141, 111095 (2020).

[23]. DeJong EN, Surette MG, Bowdish DM *et al.* The Gut Microbiota and Unhealthy Aging: Disentangling Cause from Consequence. *Cell Host & Microbe.* 28, 180-189 (2020).

[24]. Warman DJ, Jia H, Kato H *et al.* The Potential Roles of Probiotics, Resistant Starch, and Resistant Proteins in Ameliorating Inflammation during Aging (Inflammaging). *Nutrients.* 14, 747 (2022).

[25]. Fong BY, Chiu WK, Chan WF *et al.* A Review Study of a Green Diet and Healthy Ageing. *Int J Environ Res* 18, 8024 (2021).

[26]. Kim J-Y, Lee Y-C, Kim S-G, Garagiola U. Advancements in oral maxillofacial surgery: A comprehensive review on 3D printing and virtual surgical planning. Appl Sci. 2023;13(17):9907.

[27]. Sahim S, El Quars F. Virtual planning versus traditional planning in orthodontic-surgical treatment: A review. OALibJ. 2023;10(7):1–9.

[28]. Sugiaman VK, Jeffrey, Naliani S, et al. Polymeric scaffolds used in dental pulp regeneration by tissue engineering approach. Polymers (Basel). 2023;15(5):1082 31.

[29]. Xie Z, Shen Z, Zhan P, et al. Functional dental pulp regeneration: Basic research and clinical translation. Int J Mol Sci. 2021;22(16):8991.

[30]. Zoabi A, Redenski I, Oren D, et al. 3D printing and virtual surgical planning in oral and maxillofacial surgery. J Clin Med. 2022;11(9):2385.

[31]. Rosen J, Hannaford B, Satava et al. Surgical robotics. Philadelphia: Springer US. 2011.

[32]. Zoabi A, Redenski I, Oren D, et al. 3D printing and virtual surgical planning in oral and maxillofacial surgery. J Clin Med. 2022;11(9):2385

[33]. Dadhich A, Nilesh K, Shah S, Saluja H. Three-dimensional printing in maxillofacial surgery: A quantum leap in future. Natl J Maxillofac Surg. 2022;13(Suppl.1):S203-S11.

[34]. Yan KX, Liu L, Li H. Application of machine learning in oral and maxillofacial surgery. Artif Intell Med Imaging. 2021;2(6):104–14.

[35]. Patil S, Albogami S, Hosmani J, Mujoo S, Kamil MA, Mansour MA, et al. Artificial intelligence in the diagnosis of oral diseases: applications and pitfalls. Diagnostics (Basel). 2022;12(5):1029.

[36]. Abdul NS, Shivakumar GC, Sangappa SB, Blasio MD, Crimi S, Cicciù M, et al. Applications of artificial intelligence in the field of oral and maxillofacial pathology: a

systematic review and meta-analysis. BMC Oral Health. 2024;24(1):122.

[37]. Hartoonian S, Hosseini M, Yousefi I, Mahdian M, Ahsaie MG. Applications of artificial intelligence in dentomaxillofacial imagingA systematic review. Oral Surg Oral Med Oral Path Oral Rad. 2024;138(5):641–55.

The Confluence Of Scalpel And Science: Future Horizons For Oral And Maxillofacial Surgeons In Forensic Odontology

Abstract

Background : Forensic odontology is a critical discipline in medico-legal investigations, relying on dental evidence for human identification and trauma analysis. Oral and maxillofacial surgeons (OMFS), with their advanced surgical training and craniofacial expertise, are increasingly recognised as key contributors to this field. Their skills in performing oral autopsies and detailed comparative dental analyses complement forensic protocols where conventional methods may be inadequate.

Aim: This review examines the evolving and pivotal role of OMFS in forensic odontology, highlighting their technical competencies in oral autopsy, dental identification, trauma interpretation, DNA sampling, and medico-legal testimony. It also identifies current educational and infrastructural gaps and proposes future directions for integrating OMFS into forensic practice in India and beyond.

Methods: A narrative synthesis of contemporary literature and professional guidelines was conducted to summarise OMFS contributions to forensic investigations and emergent technologies impacting this interface. Key themes included surgical forensic techniques, imaging modalities, genetic sampling methods, and institutional frameworks.

Results: OMFS contribute via oral autopsy, advanced imaging (including AI-enhanced CBCT and virtual autopsy), and detailed comparative dental analysis for identification. They support forensic reconstruction via 3D/4D printing, high-fidelity DNA sampling from dental tissues, and meticulous interpretation of orofacial trauma. Nevertheless, forensic training programmes and infrastructure are sparse in India, emphasising the need for dedicated curriculum reform, specialised forensic fellowships, and formal integration of OMFS into disaster-victim identification and medico-legal task forces.

Conclusion: OMFS possess unique expertise that substantially bolsters forensic odontology. To realise this potential, targeted training, robust laboratory facilities, and adoption of advanced technologies are imperative, particularly in developing nations. Curriculum development, interdisciplinary collaborations, and formal recognition of OMFS roles in disaster victim identification and medico-legal investigations will drive future progress in this discipline.

KEY WORDS: Oral and Maxillofacial Surgeon, Forensic Odontology, Odontometrics, DNA, AI, 3D Printing

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INTRODUCTION

Within dentistry, forensic odontology is a separate and specialised field that deals with the careful handling, analysis, and interpretation of dental evidence. Its roots can be found in the Roman Empire in 49 AD, when human identification relied heavily on dentition. Because of their durability and individuality, teeth are considered essential biometric identifiers. In general, the field is divided into three main areas: criminal investigations, academic or scientific research, and civil (non-criminal) matters.[1] Interestingly, the INTERPOL guidelines for Disaster Victim Identification emphasise how important it is to have a dentist with medico-legal knowledge examine the jaws and dentition whenever possible.[2] The role of Forensic odontology has become a vital component of medicolegal investigations, particularly in human identification. The discipline broadly encompasses identification of remains, malpractice litigation, and criminal inquiries especially bite-mark analysis and cases of abuse, notably involving children.[3] It helps with criminal analysis, mass fatality response, age/sex estimation, bite-mark interpretation, and identity verification.[2] According to Pillai.J.P et al, proper academic programme and the practical implication process of Forensic Odontology is increased in India but still there is a lake of awareness in many specialties, this survey was undertaken to assess the extent of awareness surrounding this emerging specialty, the study further revealed that respondents possessed limited awareness regarding the practical integration of forensic odontology into everyday dental practice.[4] It recommended that the Dental Council of India introduce a distinct and dedicated curriculum on forensic odontology to enhance professional competence in this domain.

Other dental specialities like Orthodontics and Oral and Maxillofacial Surgeons (OMFS), owing to their comprehensive surgical acumen and deep anatomical knowledge, play a pivotal role in intricate forensic investigations, ranging from performing detailed oral autopsies to delivering authoritative expert testimony within judicial proceedings. According to Reddy G et al., Orthodontists can also significantly contribute to the identification of victims or suspects by keeping comprehensive and accurate diagnostic records. Past and ongoing tragic events have underscored the growing relevance of forensic dentistry in identifying deceased individuals or disaster victims. With the anticipated rise in mass fatalities due to terrorism, natural calamities such as earthquakes, and other catastrophic events, orthodontists can employ advanced software and utilise superimposition techniques on lateral cephalometric radiographs to aid in the facial reconstruction of victims to a considerable degree.

ROLE OF ORAL SURGEONS:

Primary human identification modalities are left thumb impression, cornea, dental anatomy, anterior palatal rouge, 2-deoxyribonucleic acid etc. (Fig. 1 & 2)

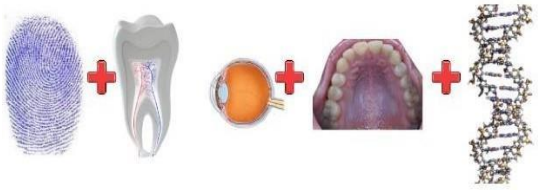


Fig. 1

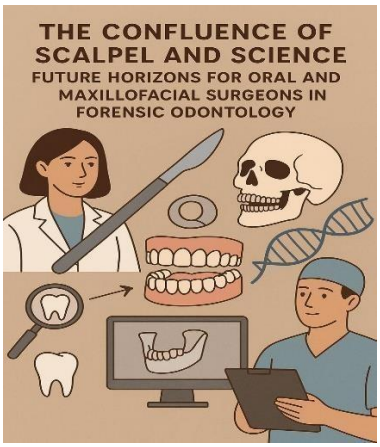


Fig. 2

i) Oral Autopsy & Surgical Access

In forensic investigations, an oral autopsy entails the meticulous dissection of the jawbones and surrounding soft tissues to facilitate comprehensive examination, an essential procedure, particularly in cases involving advanced decomposition, incineration, or skeletal remains.[7] Studies consistently show that these specialised methods greatly improve dental charting accuracy and make it easier to obtain radiographic images for comparison.[7] Experts maxillofacial surgery (OMFS) have the high level of technical skill necessary to perform osteotomies, jaw disarticulation, and accurate surgical explorations while maintaining vital dental structures necessary for identification. Their controlled handling maintains forensic validity.

ii) Comparative Dental Analysis & Human Identification

The comparison of ante-mortem and post-mortem dental records serves as a fundamental method in the identification of unknown remains, a process in which the expertise of OMFS professionals plays an indispensable: Proper radiographic alignment and 3D imaging acquisition (CBCT, virtual autopsy), Surgical documentation of prosthetics, restorations, and implants, Ensuring the integrity of dental evidence, Disaster Victim Identification (DVI), Dental identification remains reliable where other methods fail, especially in fire, decomposition, or skeletal remains[2].

iii) Age and Sex Estimation from Dental Evidence

In order to study human variation and facilitate identification, odontometrics is the exact measurement and analysis of tooth dimensions, is primarily used in fields like biological anthropology, bioarchaeology, and forensic science because dental morphometry is said to be guided by physiological, pathological, environmental, genetic, ethnic, and racial factors[13]. In order to assess tooth size, morphology, and associated characteristics, this field entails the painstaking recording of dental metrics from both skeletal remains and dental models.[13]

Atlas I et al. has shown in their study that dental age estimation is among the most accurate techniques for determining an individual's age. Forensic physicians and pathologists frequently use dental panoramic radiography (DPR) to establish chronological age, particularly when working with unidentified individuals who lack official patient records or legal documentation.[16]

OMFS can attribute in this domain by: Collecting samples for histology or CBCT/OPG analysis, Coordinating

age-estimation protocols, Maintaining forensic chain-of-custody etc.

iv) Legal Importance-

The recent incorporation of AI in CBCT enhances accuracy under OMFS supervision. Future integration of AI and imaging promises further refinement.

v) Bite-Mark Examination & Dental Trauma Analysis

Despite ongoing controversy, bite-mark evidence is still used in forensics with strict validation.[2] Because of their specialised knowledge, the participation of OMFS professionals greatly increases its dependability. Expert interpretation of soft- and hard-tissue trauma, Differentiation of antemortem vs. post-mortem injuries, High-resolution photography and 3D scanning. Their deep understanding of oral anatomy is indispensable for reconstructing mechanisms of injury.

vi) DNA Sampling from Teeth

Dental pulp tissues in teeth serve as remarkably robust and reliable reservoirs of DNA, even in severely degraded or compromised remains. The meticulous techniques employed by oral and maxillofacial surgeons, such as precise sectioning, root canal drilling, and pulp tissue extraction, are instrumental in obtaining high-integrity DNA samples. These procedures, executed with stringent contamination control, significantly enhance the quality and reliability of genetic profiling. (Fig. 3&4)

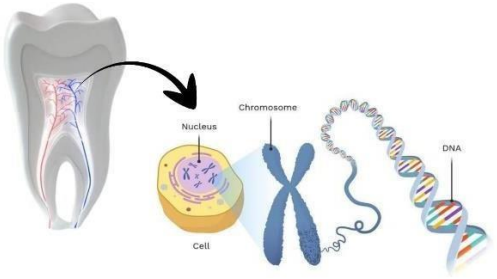


Fig. 3

Fig.4

vii) Expert Testimony & Interdisciplinary Collaboration

OMFS frequently function as expert witnesses in forensic cases. Their responsibilities include: Presenting and interpreting dental/radiographic findings, explaining sample collection and analysis methods, clarifying limitations (e.g., bite-mark reliability). Their combined command of knowledge as both surgical experts and forensic practitioners would reinforce judicial trust and enhance the weight of their testimony within legal proceedings. These methodologies are accepted within legal frameworks and endorsed by the scientific community as reliable tools for objectively distinguishing factual evidence from falsehoods. Nonetheless, despite its growing relevance, forensic odontology

continues to be insufficiently understood or appreciated among dental practitioners.[10]

viii) Current Education & Training Gaps

Despite their potential knowledge, many OMFS lack basic formal forensic training in: Undergrad/postgrad curricula in India only marginally include forensic odontology[1], Few structured programs or labs allow OMFS to develop FO skills, Antemortem records are often poorly maintained, reducing comparative analysis effectiveness[1,5]. Internationally, programs exist (Canada's Bureau of Legal Dentistry; US ABFO), but OMFS-focused forensic fellowships remain limited.[4] India's NFSCU and DY Patil programs are emerging but still rare.[1]

ix) Retention of Implant Batch Numbers Post-Incineration: A Forensic Aid in Human Identification.

Dental identification entails matching post-mortem findings with antemortem dental records associated with a specific individual. Several techniques are employed to identify dental implants in the deceased, including intraoral radiographs, three-dimensional imaging, computed tomography (CT), and panoramic radiography. In a study by John W. Berketa, Robert S. Hirsch, Denice Higgins, and Helen James, implant batch numbers were visualised using a WILD Heerbrugg microscope equipped which has a attached digital camera. The batch numbers were distinctly visible prior to incineration. Post-incineration, the identifiers remained discernible, particularly where an oxidation layer was present. The persistence of the batch number is influenced by the depth of the etching and the thickness of the resultant oxidation layer.[14] According to Berketa. J et al, the dental implant batch number is resistant to incineration procedures, which might be used for disaster victim management identification scenario and can lead a new era of DVI, incinerated human remains identification. [17] (Fig. 5 & 6). [17]

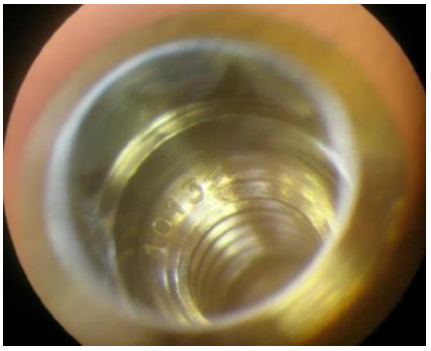


Fig. 5 Before Incineration

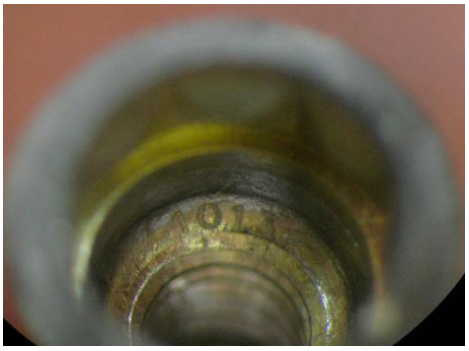


Fig. 6 After Incineration

x) Domestic Violence and Child Abuse

The World Health Organization (WHO) recognises violence as a major and escalating global public health concern. A key objective of this declaration is to equip healthcare professionals to identify and address instances of violence, particularly involving vulnerable groups such as children, women, and the elderly. The

WHO categorises violence into four primary forms: physical, sexual, psychological, and neglect. The orofacial region is a common site for manifestations of such abuse, making it essential for dental professionals to remain vigilant. Clinical signs may include fractures of anterior teeth, alveolar bone damage, lacerations of the labial and buccal mucosa, frenum tears, and contusions to the lips, face, or neck. These injuries should raise a dentist's index of suspicion. OMFS as a team member of the emergency team and the trauma management team, while suspicion warrants further investigation and potential reporting, such actions must be approached with careful clinical judgement and ethical responsibility [9]

DISCUSSION:

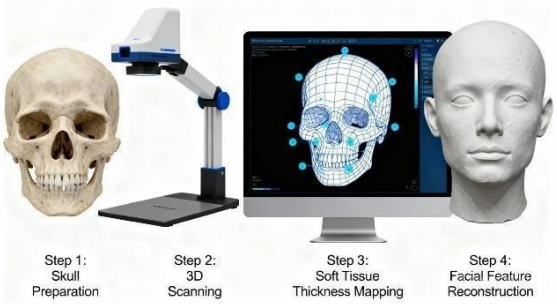
Forensic odontology is an evolving discipline of significant societal relevance. In recent decades, the demand for forensic expertise has surged, driven by the growing needs of the criminal justice system. However, in India, the application of forensic odontology within legal and investigative frameworks remains limited and underutilised.[8] The interface between OMFS and forensic odontology is symbiotic. OMFS brings anatomical and surgical precision is essential for oral autopsy, interpretive insight on trauma and restorative evidence, and Forensic integrity in sample handling. Future adoption of AI, imaging, and 3D tools will further solidify their role but success depends on structured training, legal reforms, and inter-agency cooperation. While bite-mark analysis remains controversial, other modalities (DNA, dental ID, imaging, skeletal anatomy analysis, and implant serial number) demand OMFS involvement.

FUTURE PROSPECTS & TECHNOLOGICAL INNOVATION:

Technological evolution is reshaping the OMFS role in forensic odontology. Contemporary advancements in forensic odontology have seen the introduction of innovative techniques such as facial reconstruction, denture marking, DNA profiling, and lingual print analysis.[6]

a) 3D/4D Printing & Surgical Guides-

Additive manufacturing facilitates the precise fabrication of 3D printed jaw replicas or bite models, proving invaluable for anatomical reconstruction and expert demonstration within forensic contexts, which were traditionally employed by the Anthropometrical American method, Anatomical method, and British method, but have since been superseded by advanced computerised 3D facial reconstruction techniques utilising various software platforms integrated with haptic feedback systems.[12] OMFS can guide the fabrication and validation of these models. (Fig. 7)

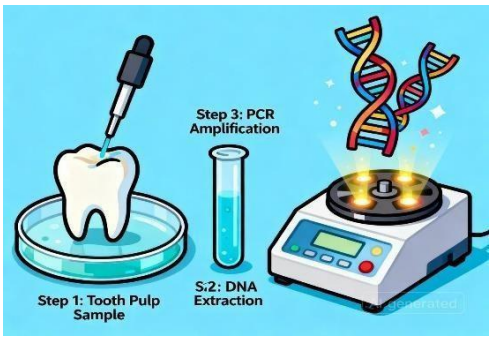


b) AI-Enhanced CBCT & Virtual autopsy-

The development of AI technologies has changed the way dental CBCT data is evaluated, significantly increasing its use in dentistry. Now, researchers are employing publicly available CBCT datasets to test their algorithms. In the future, AI could help in associating fragmentary dental x-rays with the corresponding databases. The advancement of such algorithms has led to more accuracy and better optimization of processes, which in turn drives the development of new technologies in AI dentistry.[5] However, some issues regarding the implementation of AI technologies in conjunction with CBCT data still need to be resolved. Artificial intelligence-based segmentation and pattern recognition significantly support the automated estimation of age and the identification of traumatic injuries. However, the oversight of OMFS specialists remains essential to uphold diagnostic precision and reliability. Virtual autopsy (post-mortem CT/CBCT) offers non-invasive alternatives where traditional autopsy is limited.[7]

c) Advanced DNA Micro-Sampling-

Enamel protects the pulp chamber's contents from outside influences. Its main ingredient, crystals of hydroxyapatite, binds to DNA to stabilise and preserve it. As a result, teeth offer a wealth of DNA for examination.[6] Refined pulp retrieval techniques leveraging micro-drills and low-impact sectioning preserve dental morphology while enabling genetic profiling.



d) Teleforensics & Remote Consultation-

Virtual collaborations, enhanced by digital imaging and secure data sharing, allow OMFS to contribute across jurisdictions, disaster zones, and rural settings.

e) Utilisation of Saliva as a source of forensic evidence-

According to Upadhya et al., Saliva, second only to blood, is among the most frequently encountered biological traces at crime scenes. It's clear and often inconspicuous nature renders it less susceptible to tampering by perpetrators. In forensic investigations, saliva serves as a valuable source of biological evidence, aiding in the determination of key individual characteristics such as sex, identity, ABO blood group, microbial profile, specific biomarkers, and personal habits, including smoking.[11]

To realize the OMFS potential in India:

The future potential area could be improvised and modified according to the need for our country, we can focus on a few important points such as, making FO a compulsory component of BDS/MDS, with rotating modules in OMFS departments to evaluate traumatic injuries by utilisation of

their thorough anatomical knowledge. Research incentives: Encourage publication in FO and AI imaging, as well as ABFO certification pathways. India-Specific Recommendations: OMFS can teach forensic autopsy related anatomy in various colleges, workshops Forensic fellowships: Collaborate with institutions like NFSCU to offer OMFS-focused training. District-level labs: Equip OMFS-led forensic units with imaging, DNA, and autopsy capabilities. Mandate records: Enforce legally binding retention of dental and radiographic records for 7- 10 years. Multidisciplinary drills: Integrate OMFS into mass-disaster and medico-legal task forces.

CONCLUSION:

With their advanced surgical skills, precise analytical knowledge of trauma, and also having access to the casualty and emergency team, expert DNA retrieval, and credible testimony in court, oral and maxillofacial surgeons are invaluable resources in the field of forensic science. Targeted education, strong laboratory infrastructure, and the integration of contemporary technologies are urgently needed to fully realise their potential, especially in developing nations like India. With the ongoing advancements in imaging, AI, and additive manufacturing, OMFS specialists' roles in forensic odontology are expected to grow in importance and integration.

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CONFLICT OF INTEREST:

The authors declare that there are no conflicts of interest.

REFERENCES:

1. Khattar B, Sharma A, Tomer G, Shrinivaasan NR,Mulla M, Sharma A, et al. Knowledge, awareness, and attitude on malocclusion in nursing students. J Pharm Bioall Sci 2025;17:S326-8

2. Roy J, Shahu U, Shirpure P, Shoni S, Parekh U, Johnson A. A literature review on dental autopsy. Autopsy Case Rep. 2021;11:e2021295.^7

3. Pillai.Jp. et al, Awareness of Forensic Odontology among Dental Students, Academicians, and Dental Practitioners in Gujarat: A Questionnaire Based, Cross Sectional Study; Journal of Forensic Dental Sciences, Vol 12(1), January-April 2020, p. 10-22

4. Rathod V, Desai V, Pundir S, Dixit S, Chandraker R. Role of forensic dentistry for dental practitioners: A comprehensive study. J Forensic Dent Sci 2017;9:108-9.

5. Sarwar, Saba & Jabin, Suraiya. (2023). AI Techniques for Cone

Beam Computed Tomography in Dentistry: Trends and Practices. 226-231. Doi: 10.1109/REED-CON57544.2023.10151069.

6. Menon PA, Kumar NA. Recent advances in forensic odontology: An overview. J Forensic Sci Med 2021;7:105-8.

7. Khan MS, Suhartono AW, Auerkari EI. Clinical Implications of Dental Injury Analysis in Forensic Odontology:A Review Article. e-GiGi; Volume 13, Nomor 1: 217-224

8. Shetty P, Raviprakash A. Forensic odontology in India, an oral pathologist's perspective; J Forensic Dent Sci; January-June 2011, Vol 3, Issue 1

9. Hinchliffe J. Forensic odontology, part 5. Child abuse issues. Br Dent J. 2011 May 14;210(9):423-8

10. Rehman. I.U., Awareness of forensic odontology among dental professionals; Pak Oral Dent J 2021; 41(3):173-76.

11. Upadhyay et al., Recent advancements in identification and detection of saliva as forensic evidence: a review; Egyptian Journal of Forensic Sciences, 2023) 13:17

12. Abraham, John & Suresh, Kevin & Jacob, Anieta. (2025). Three-Dimensional Printing in Forensic Odontology: A Transformational Tool for Identification and Analysis. journal of research in dental sciences. 5. 63-70.

13. Pillai JP. "Odontometrics:" A need for anthropological data. J Forensic Dent Sci 2018;10:59-60.

14. Deepalakshmi and Prabhakar., Role of dental implants in forensic identification; Journal of Forensic Dental Sciences; May-August, 2014, Vol 6, Issue 2

15. Giridhar Reddy et al., Orthodontist Role in Forensic Odontology- A Social Responsibility; Journal of Clinical and Diagnostic Research. 2016 Apr, Vol-10(4): ZE01-ZE03

16. Ataş, İsa & Ozdemir, Cuneyt & Ataş, Musa & doğan, Yahya. (2022). Forensic Dental Age Estimation Using Modified Deep Learning Neural Network. 10.48550/arXiv.2208.09799.

17. J. Berketa, V. Marino, H. James; Survival of batch numbers within dental implants following incineration as an aid to identification, J Forensic Odontostomatol 2010;28:1:1-4

Recent Advances in Impression Materials and Techniques in Complete Denture Prosthodontics

Abstract

Accurate impressions are essential for successful complete dentures, influencing retention, stability, and patient comfort. Conventional workflows using alginate, impression compound, ZOE, and elastomeric materials have improved over time, yet remain vulnerable to distortion and multi-step procedural errors. Advances such as polyvinyl siloxane, polyether, and hybrid vinyl siloxanether offer superior dimensional stability and detail reproduction. The introduction of intraoral scanning and CAD/CAM has reduced appointments, eliminated cast-related inaccuracies, and improved patient acceptance, although accuracy in edentulous arches depends on scanner performance and clinician expertise. Evidence remains mixed regarding absolute superiority over conventional methods. Current research supports a hybrid, case-specific approach, with artificial intelligence expected to enhance future denture precision and personalization.

Keywords: 3D printing; Artificial intelligence; CAD/CAM dentures; Complete denture prosthodontics; Digital workflow; Impression materials; Intraoral scanning; Milled dentures; Patient satisfaction; Polyether; Polyvinyl siloxane; Vinyl siloxanether.

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INTRODUCTION

A dental impression is fundamentally defined as a negative imprint or a positive digital image used to create an accurate replica of the oral anatomy, a critical step in the fabrication of dental restorations and prostheses.[1] The success of a complete denture is directly linked to the quality of this impression, which is determined by the material chosen, the specific technique employed, and the unique needs of the patient.[1] This necessity for successful prosthetic rehabilitation is only increasing, as complete edentulism remains a significant public health challenge, particularly within aging global populations.[2]

For decades, the conventional workflow for complete dentures (C-CD) has been the standard approach. This traditional, analog methodology is characterized by multiple stages, including preliminary and final impressions, jaw relation records, try-ins, and laboratory phases like pouring casts and wax-ups.[2] While time-tested, this multi-step process is prone to cumulative errors, material shrinkage, tissue distortion, and often leads to the need for frequent post-insertion adjustments.[2] Historically, the evolution of materials—from waxes and compounds to modern elastomers—has continuously influenced and improved impression procedures.[3]

In recent years, however, new technologies and materials have surged, presenting a formidable alternative to the analog chain of custody.[1] The shift toward digital dentistry, specifically through CAD/CAM systems, is fundamentally changing the landscape of prosthodontics. The implementation of digital techniques has enabled the fabrication of complete dentures in as few as two sessions, promoting greater agility and precision, enhancing patient comfort, and significantly reducing the likelihood of procedural errors inherent to manual steps.[5] Given the rapid pace of this technological adaptation, it is crucial for clinicians to possess a comprehensive understanding of both advanced conventional materials and the digital workflow to select the optimal approach for each clinical case.[1] This review serves to synthesize this vast information, comparing traditional and digital advancements and offering perspectives on the future of complete denture prosthodontics.

1. The Foundation: Conventional Impression Materials and Techniques

1.1. Traditional Materials and Their Distinctive Properties

The fabrication of complete dentures has historically been a multi-step, analog process, beginning with the meticulous recording of the patient's oral anatomy. This process has relied on a foundational set of materials, each with unique physical and chemical properties that dictate their clinical application.

Alginate and Impression Compound: Alginate **(Figure 1)**, an irreversible hydrocolloid, is a material of choice for preliminary impressions due to its low cost and ease of use in clinical practice.[1] Its composition includes sodium or potassium alginate, calcium sulfate (a reactor), and diatomaceous earth, which serves as a filler to provide strength and stiffness.[4] A significant drawback of alginate is its inherent dimensional instability. Following an impression, it is susceptible to shrinkage via syneresis (water loss) and swelling from imbibition (water absorption), necessitating that the cast be poured within 10 minutes for optimal accuracy.[1]

In contrast, impression compound is a rigid, thermoplastic material derived from a

composition of resin, and various waxes.[5] It softens when heated in a water bath and hardens upon cooling, a property that makes it ideal for border molding and capturing preliminary impressions of edentulous arches.[6] The clinical process involves softening the compound in a water bath, molding it, and loading it into a tray to capture the impression.[5] Due to its high viscosity, it creates a mucocompressive impression that tends to lack the ability to reproduce fine surface details.[10] However, its reusability and adjustability make it a valuable tool in the traditional workflow.[5]

Fig 1: Alginate Powder

Zinc Oxide Eugenol (ZOE): Zinc Oxide Eugenol (ZOE) **(Figure 2)** impression paste is a rigid, highly stable material used for definitive impressions of edentulous arches.[9] The material sets via an irreversible chemical reaction between zinc oxide and eugenol, which results in the formation of zinc eugenolate.[12] The procedure for ZOE involves dispensing the base and catalyst pastes, mixing them on a pad until a uniform color is achieved, and then loading the material into the tray.[5] This reaction yields a material with excellent dimensional stability and the capacity to reproduce fine surface details with high fidelity.[9] A notable clinical disadvantage, however, is the potential for a burning sensation in some patients, a side effect of the eugenol content.[12]

Fig 2: Zinc Oxide Eugenol

1.2. Conventional Analog Impression Protocols

The traditional analog workflow for complete dentures is a meticulously choreographed, two-step procedure designed to compensate for the limitations of the materials used. The process begins with a preliminary impression, often taken with a stock tray and a material like alginate or impression compound, to create an initial cast.[1] A custom impression tray is then fabricated on this preliminary cast.[14] This custom tray is subsequently border-molded, a process that captures the functional movements of the peripheral tissues using materials like impression compound or elastomeric materials.[1] The final impression is then taken with a high-detail material such as ZOE or a light-body elastomer.[1]

The inherent challenges of this multi-stage process have led to the development of numerous specialized techniques aimed at optimizing specific clinical outcomes. The **Modified Wax Impression Technique (Figure 3)**, for instance, creates an accurate impression using modeling plastic and wax spacers, with a "window" opening for a final injection of vinyl polysiloxane (VPS) material to capture finer details.[15] The **Flange Technique**, introduced by Frank Lott and Bernard Levin in 1966, employs impression wax to record the soft tissues in a functional state, with the goal of creating extensions that can improve denture

retention and stability.[15] Other techniques, such as the **Admixed Technique (Figure 4)** and the **All Green Technique (Figure 5)**, involve blending different compounds to create a uniform mass for capturing border movements before a final impression is made with ZOE.[15] The ongoing development of these various conventional techniques underscores a persistent challenge in analog prosthodontics: the quest to overcome the inherent limitations of materials and the procedural vulnerabilities of the multi-step workflow. These efforts highlight a historical search for a more reliable and reproducible method, a void that the digital revolution now seeks to fill.

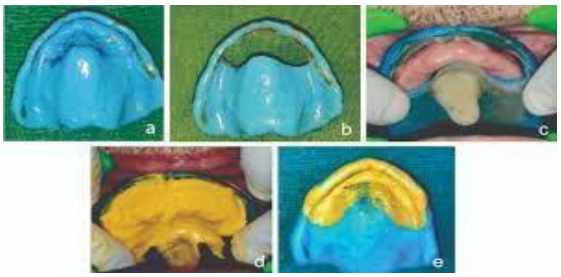


Fig 3: Modified Wax Impression Technique

Fig 4: Admixed Technique

Fig 5: All Green Technique

2. Evolution of Analog Materials: Enhanced Performance and Hybridization

2.1. The Pre-eminence of Elastomeric Materials

Over the past several decades, the development of elastomeric (or "rubber-based") impression materials has significantly advanced the quality and accuracy of conventional impressions. These materials, which include addition silicones (like polyvinyl siloxane) and polyethers, exhibit superior mechanical properties, such as high elastic recovery and dimensional stability, which are critical for capturing and maintaining the fine details of intraoral structures.[2]

Polyvinyl Siloxane (VPS): Polyvinyl Siloxane (VPS), an addition-reaction silicone, is considered a state-of-the-art elastomeric material in prosthodontics.[2] This material possesses exceptional properties, including excellent dimensional stability, with a reported shrinkage of just 0.05% over 24 hours.[17] It also has superior elastic recovery, which means it can return to its original form with minimal permanent deformation after being removed from undercuts.[2] Clinically, VPS is available in various viscosities, from heavy body for the tray to extra-low viscosity for the wash, allowing for a customized impression technique.[18] While naturally hydrophobic,

advancements have led to the development of new formulations that are chemically modified with surfactants to enhance hydrophilicity, improving their ability to record accurate impressions in the moist environment of the oral cavity.[2]

Polyether: Polyether impression materials are highly regarded for their superior hydrophilicity, which allows for accurate replication of oral tissues ev_2e_0n in the presence of moisture and saliva. They are known for their rigidity, excellent flow properties, and dimensional stability.[20] The material's ability to be used in a monophase technique, with a single viscosity for both the tray and the syringe, simplifies the clinical workflow and eliminates potential compatibility issues between different material consistencies.[7] This rigidity, however, can be a disadvantage as it may make the impression difficult to remove from deep undercuts and can increase the risk of fracture to the stone die.[17]

2.2. Innovations to Overcome Traditional Weaknesses

The evolution of impression materials has not been limited to the development of new classes of elastomers. Manufacturers have also focused on enhancing existing materials to overcome their traditional limitations, as well as creating new hybrid formulations that combine the best attributes of different chemistries.

Advancements in Alginate: Alginate, a long-standing staple for preliminary impressions, has been significantly improved. **Extended-pour alginates** have been developed to extend the time window for pouring the cast, with some products claiming dimensional stability for up to 168 hours when stored under specific conditions.[21] This innovation provides clinicians with greater flexibility and a larger time window for laboratory communication. **Chromatic alginates** incorporate colour-changing properties that serve as a visual guide for mixing, loading, and setting times, helping to standardize the procedure and improve consistency.[6] Furthermore, **siliconized alginates** have been introduced, which are two-paste systems incorporating a silicone polymer to enhance tear resistance, and **antiseptic alginates** contain antimicrobial agents to reduce infection risk.[21]

New Hybrid Materials: A particularly noteworthy development is the emergence of hybrid materials, such as **Vinyl Siloxanether** (PVES). This new elastomer is a chemical compound that combines a polyether polymer with the vinyl groups of VPS, a formulation designed to bring together the superior hydrophilicity of polyether with the excellent elastic recovery and dimensional stability of VPS.[19] This material offers the advantage of enhanced wetting properties and tensile strength without the need for surfactants, presenting a promising solution to the limitations of its predecessors.[19]

The continuous refinement of analog materials, from the incremental improvements to alginate to the groundbreaking development of hybrid elastomers, highlights a persistent effort to perfect the physical impression. However, regardless of the material's advanced properties, the analog workflow remains a complex, multi-stage process susceptible to a compounding of procedural variables. Each step—from manual mixing and handling to the pouring of the cast—introduces a potential source of error that cannot be fully eliminated by material science alone.[1] This fundamental limitation of the analog model is precisely what the digital revolution aims to address, shifting the focus from the material's perfection to the optimization of the entire clinical and laboratory workflow.

Material	Setting Mechanism	Key Properties	Primary Use	Clinical Advantages	Clinical Disadvantages
Alginate	Irreversible Hydrocolloid	Low dimensional stability, hydrophilic, low tear strength	Preliminary	Inexpensive, easy to use, widely available	Poor dimensional stability, low tear strength, must be poured immediately
Impression Compound	Thermoplastic	Highly viscous, mucocompressive	Preliminary, Border Molding	Reusable, can be added or removed until satisfactory	Lacks fine detail, highly viscous, mucocompressive
Zinc Oxide Eugenol (ZOE)	Rigid Paste	High dimensional stability, good detail reproduction	Final	Exceptional dimensional stability, good flow, accurate	Can cause burning sensation, rigid, cannot reproduce undercuts
Polyvinyl Siloxane (VPS)	Addition Silicone	High dimensional stability, excellent	Final	Superior dimensional stability, multiple pourings possible,	Can be hydrophobic (older formulations),
Material	Setting Mechanism	Key Properties	Primary Use	Clinical Advantages	Clinical Disadvantages
		elastic recovery, good tear strength		good biocompatibility	sensitive to latex gloves
Polyether	Polyether Elastomer	High hydrophilicity, high rigidity, good dimensional stability	Final	Excellent detail in moist environments, high flow, monophase technique possible	High rigidity can make removal difficult, less comfortable for patients
Vinyl Siloxanether	Hybrid Elastomer	High hydrophilicity, high elastic recovery, improved tensile strength	Final	Combines benefits of both polyether and VPS, excellent wettability	Newer material, limited long-term clinical data

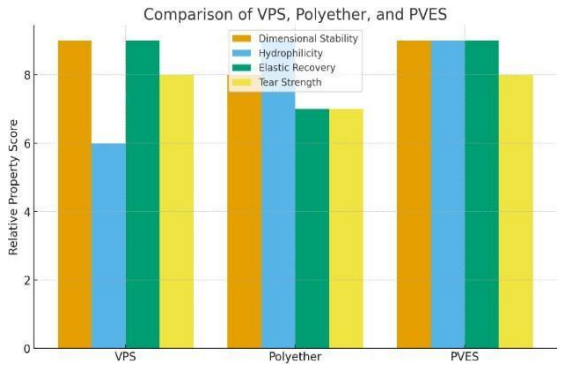


Fig 6: Comparison of VPS, Polyether and PVES

3. The Digital Revolution: Intraoral Scanning and CAD/CAM Workflows

3.1. Intraoral Scanning: A New Frontier

The advent of digital technology has introduced a paradigm shift in prosthodontics, offering an alternative to the traditional analog workflow. At the forefront of this change is the intraoral scanner (IOS), a device that uses 3D scanning technology to capture a digital, three-dimensional image of the patient's oral cavity.[8] This technology transforms the impression-taking process from a physical, material-based procedure to a data-driven, virtual one.

For the patient, the benefits of intraoral scanning are immediate and significant. The use of a handheld scanner eliminates the need for messy impression materials, which can be uncomfortable and trigger a gag reflex.[23] This enhanced patient experience can increase acceptance of treatment and improve overall satisfaction. From a clinical perspective, the digital workflow offers unparalleled efficiency. The number of patient appointments can be dramatically reduced, with some workflows completing a case in as few as 2 or 3 visits compared to the 5 or more visits often required for conventional dentures.[25] Digital records also eliminate the risk of distortion that can occur from physical handling, storage, and shipping of impressions.[23]

Despite these advantages, the application of intraoral scanning for edentulous arches presents a unique set of challenges. Unlike dentate arches, edentulous arches are composed of soft, movable tissues, particularly in dynamic regions like the vestibular and peripheral seal areas.[8] Capturing these movable tissues accurately with a scanner can be challenging and requires a specific technique. Furthermore, the adoption of this technology requires a substantial initial investment, with scanner costs ranging from approximately $10,000 to over $23,000.[29] There is also a notable learning curve for clinicians to master the scanning technique for edentulous patients, which can influence the final outcome.[31]

3.2. From Digital Impression to Final Prosthesis: The CAD/CAM Workflow

Once the digital record is acquired, the denture is fabricated through a computer-aided design and manufacturing (CAD/CAM) workflow. This process is highly streamlined and reproducible, consisting of three main steps: scanning, designing, and manufacturing.[31] The digital scans are sent to a dental lab where a technician uses CAD software **(Figure 7)** to virtually design the denture.[31] This includes the selection of tooth shape, shade, and arrangement, which can be shared with the clinician for review and approval before fabrication begins.[31]

The virtual preview allows for a meticulous evaluation of the denture design before manufacturing begins.[33] This includes confirming a symmetrical tooth arrangement, appropriate occlusal vertical dimension, and the correct alignment of the occlusal plane with anatomical landmarks like the retromolar pads.[33] It also enables the technician to check for common errors, such as teeth placed on the ascending part of the ramus or over the maxillary tuberosities.[33] Furthermore, the design can be evaluated for proper posterior denture base extension to cover critical areas like the pterygomaxillary fissures and buccal shelf.[33]

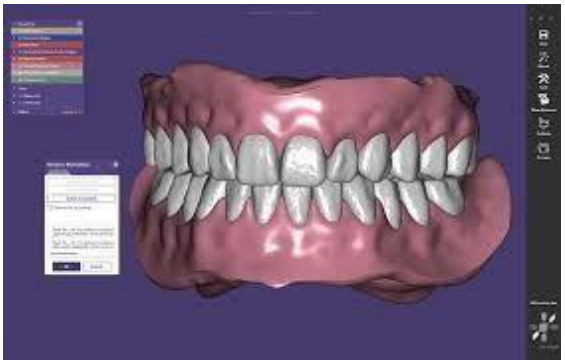


Fig 7: Computer Aided Design Software

The final step, CAM fabrication, can be accomplished through two primary methods: subtractive milling and additive 3D printing. **Subtractive milling (Figure 8)** involves carving the denture from a pre-polymerized puck of poly(methyl methacrylate) (PMMA).[26] This process is known for producing dentures with superior mechanical properties and a lower residual monomer content than conventional heat-polymerized PMMA, resulting in improved strength, fit, and retention.[26] However, milling creates a notable amount of material waste because a large portion of the blank is unused during the process.[14] It is also limited by the geometry of the cutting tools, which can impact accuracy in complex undercut areas.[14]

Fig 8: Subtractive milling

Conversely, **Additive 3D Printing (Figure 9)** constructs the denture layer by layer using light-cured resin.[18] This technique reduces material waste and can create more complex geometries because it is not limited by the accessibility of a milling bur.[14] Research indicates that 3D-printed resins, particularly newer formulations, have enhanced mechanical properties and aesthetics.[15] However, some studies indicate that printed resins may still face hallenges related to their brittleness and fracture resistance when compared to milled PMMA.[25]

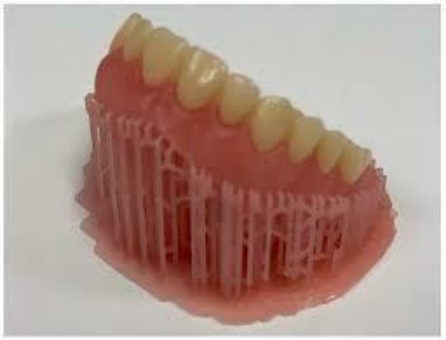


Fig 9: Additive 3D Printing

The shift to a digital workflow fundamentally changes how errors are introduced and managed. In the analog process, error accumulation is a compounding issue, with each manual step—from impression to cast pouring to articulation—adding a potential source of inaccuracy. The digital workflow, by contrast, concentrates the primary source of potential error to the initial data acquisition step. Once a precise and accurate digital record is obtained, the subsequent design and manufacturing stages are highly controlled and reproducible, reducing the cascading errors that are common in the traditional method. This represents a fundamental move from a procedural error model to a data acquisition and processing error model, promising greater predictability and consistency in the final prosthesis.

Conventional	Digital
Preliminary ↓ Custom tray ↓ Border molding ↓ Final impression ↓ Jaw relation ↓ Try-in ↓ Insertion ↓ Adjustments	Scan ↓ CAD Design ↓ Try-in (optional) ↓ Manufacture ↓ Insertion

4. Comparative Clinical Efficacy and Patient Outcomes: Conventional vs. Digital

4.1. A Nuanced Look at Accuracy

The comparative efficacy of conventional versus digital denture workflows remains a subject of active research, with studies presenting a complex and sometimes conflicting picture. The question of which method produces a more accurate final prosthesis is not straightforward. On one hand, some studies have concluded that conventional impressions, when performed with high-precision materials, have a greater overall accuracy than digital impressions for full-arch rehabilitations.[23] Other research, however, finds no significant difference in accuracy between the two methods.[23]

This apparent contradiction can be understood by examining the sources of potential error in each workflow. While an analog impression material may theoretically possess superior dimensional fidelity, the conventional workflow is prone to a compounding of inaccuracies from multiple stages. These include distortions from material handling and storage, as well as errors introduced when pouring the master cast and during subsequent laboratory procedures.[13] In this context, even a highly accurate initial impression can result in a final prosthesis with a significant marginal discrepancy, which may lead to biological complications like secondary caries or periodontal disease.[13] The digital workflow, by eliminating many of these manual steps, provides a more predictable outcome, even if the initial scan may have its own challenges, particularly in dynamic areas.[23]

Within the digital domain, a comparison of the two primary manufacturing methods also reveals nuanced differences. Milled denture bases have been shown to be more accurate in the overall intaglio and primary stress-bearing areas, while 3D-printed bases may offer greater accuracy in

peripheral and undercut areas that are not suitable for milling technology.[14] This finding suggests that the choice of digital fabrication method should not be a universal preference but rather a strategic decision based on the specific clinical anatomy of the patient.

4.2. Patient Satisfaction and Clinical Efficiency

Beyond laboratory metrics, the most critical factors for clinical success are patient satisfaction and workflow efficiency. On the subject of patient satisfaction, the research is also not uniform.

One study found that patients who wore digital dentures (D-CD) reported significantly higher satisfaction in domains such as comfort, retention, speech, and mastication compared to conventional dentures (C-CD)[36] **(Figure 10).**

In a crossover study where patients experienced both types of dentures, the majority of participants expressed a clear preference for the digitally fabricated prosthesis.[5] Conversely, another study noted that patients and dental students involved in the fabrication process preferred conventional dentures, and that digital dentures required more occlusal adjustments.[38]

This discrepancy highlights a critical aspect of the digital transition: the success of the new technology is closely tied to the proficiency of the clinician. The study where dental students preferred conventional methods noted that they were more familiar with the traditional wax try-in and workflow.[38] The learning curve associated with mastering intraoral scanning and CAD design can lead to initial procedural errors that may not be apparent until the try-in or delivery stage, necessitating more chairside adjustments and negatively impacting patient experience.[10] Therefore, a patient's satisfaction with a digitally fabricated denture may be less a reflection of the technology itself and more a measure of the provider's expertise.

In contrast to the mixed findings on accuracy and satisfaction, there is an overwhelming consensus on a single, indisputable metric: workflow efficiency **(Table 2)**. Multiple sources consistently report that digital dentures require significantly fewer patient appointments from start to finish. The conventional process typically requires five or more visits, whereas the digital workflow can be completed in as few as two to three.[25] This efficiency extends to postoperative care, with digitally fabricated dentures requiring fewer adjustments, which further reduces chairside time and patient visits.[26] This reduction in treatment time is a major advantage for both the clinician and the patient, particularly for individuals with limited mobility or complex schedules.[36]

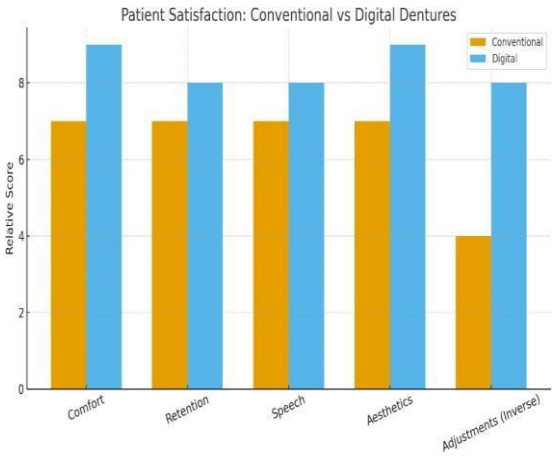


Fig 10: Patient Satisfaction

Table 2: Workflow and Clinical Outcome Comparison: Conventional vs. Digital

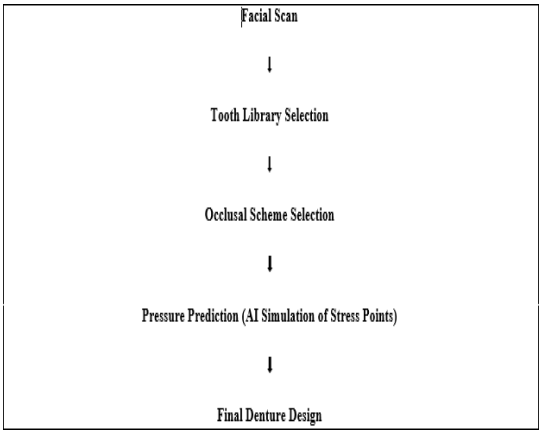
Characteristic	Conventional Workflow	Digital Workflow	Notes/Caveats
Number of Appointments	5+ visits (impression to delivery) [26, 27]	2-3 visits (scanning to delivery) [25]	Clear consensus on reduced appointments and chairside time for digital workflows.
Number of Post-op Visits	2-3 postoperative visits on average [26]	1-2 postoperative visits on average [26]	Fewer adjustments required for digital dentures, though some studies note more occlusal adjustments.[38]
Patient Satisfaction	Mixed results, but can be high. Some studies show preference for conventional.[38]	Mixed results, but can be high. Some studies show significant preference for digital in multiple domains.[36]	Patient satisfaction is heavily influenced by the clinician's proficiency with the respective workflow.
Cost	Lower initial equipment cost	High initial investment in scanners and software [29]	Long-term cost-effectiveness of digital workflow is improved by reduced labour and chairside time.[31]

5. The Future Trajectory of Complete Denture Prosthodontics

5.1. The Integration of Artificial Intelligence (AI)

The future of complete denture prosthodontics is poised for even greater transformation with the integration of artificial intelligence (AI) and machine learning. AI is already being used to analyze a patient's facial and oral anatomy, allowing for a personalized and esthetically pleasing denture design.[24] By analyzing thousands of data points, AI can suggest tooth shapes and arrangements that are in harmony with the patient's facial symmetry and expressions.[30]

Beyond esthetics, AI can apply biomechanical principles to optimize occlusal schemes and predict how a denture will function during chewing and speaking.[30] This predictive analysis can help identify and resolve potential pressure points and stress zones during the design phase, which helps reduce the need for chairside adjustments after fabrication.[30] The continuous learning of these AI systems, where data from every new case is used to refine the algorithms, will lead to a continuous improvement in the precision and comfort of future denture designs.[24] This evolution represents a shift from a manual, technician-driven design model to a predictive, data-driven one, where the design process becomes more efficient and more tailored to the individual patient than ever before.



5.2. A Hybrid Future and the Role of the Clinician

While digital technology is rapidly gaining ground, it is not destined to make conventional methods obsolete. The most advanced practitioners will likely operate in a hybrid model, selecting the most appropriate technique for each unique clinical scenario. For a patient with a stable, firm edentulous ridge, a digital scan may be the most efficient and reliable option. However, for a patient with a highly mobile, flabby ridge or complex undercuts, a conventional impression may still be the preferred method for capturing the precise functional form of the tissues.[28] In such cases, the conventional impression or cast can be digitized with a desktop scanner, allowing the case to enter the streamlined digital workflow for design and fabrication.[25]

The coexistence of conventional and digital methods presents a more complete toolbox for the clinician. Rather than a forced choice between two mutually exclusive

approaches, the discerning practitioner can leverage the strengths of each. This approach allows for a choice between efficiency and precision, depending on the clinical scenario. The mastery of both analog and digital techniques will empower the clinician to deliver the highest standard of care, ensuring the optimal clinical outcome for every patient.

CONCLUSION

The recent advancements in impression materials and techniques have ushered in a new era of complete denture prosthodontics. The evolution of analog materials, from the enduring reliability of ZOE to the superior properties of VPS and Polyether, has incrementally improved the quality of physical impressions. However, the true revolution lies in the introduction of the digital workflow, which fundamentally changes the fabrication process from a series of error-prone manual steps to a highly reproducible, data-driven system.

While the data on direct comparisons of accuracy and patient satisfaction can be conflicting, the undeniable benefits of the digital workflow are its efficiency, reduced number of patient visits, and minimal chairside time. This makes it an attractive and patient-friendly alternative, particularly for a growing and aging edentulous population. The success of digital dentures is not a foregone conclusion of the technology itself but is directly tied to the clinician's skill and ability to navigate the learning curve and master the new workflow. The future of the field points toward an integrated, hybrid approach where both conventional and digital techniques are utilized strategically. With the growing influence of artificial intelligence, clinicians are on the cusp of being able to deliver dentures that are not only more precise and efficient to produce but are also more comfortable and personalized for the individual patient than ever before. The ultimate recommendation is for clinicians to embrace these new technologies, understanding their advantages and limitations, to provide a higher standard of care and a more positive experience for the patient.

REFERENCES

1. Tylman SD. Impression procedures for complete dentures. J Prosthet Dent. 1974 Feb;31(2):125-35.
2. Christensen GJ. Impressions: the most important step in restorative dentistry. J Prosthet Dent. 1984 Jun;51(6):830-4.
3. Sharma S, Gupta N, Kumar A. A new elastomeric impression material: a comparative study. BMC Oral Health. 2020 Apr 16;20(1):101.
4. Pillai H. PVS and polyether impression material properties review. World J Oral Dent. 2018;5(2):64-70.
5. Ali M, Hassan H, Omar N. Dimensional changes and elastic recovery of new polyether impression materials. J Mech Behav Biomed Mater. 2023 Jul;142:105847.
6. Petrie CS, Walker MP, Williams K. A survey of U.S. prosthodontists and dental schools on impression procedures for complete dentures. Clin Cosmet Investig Dent. 2013;5:1-9.
7. Jadhav M. Influence of digital versus conventional impressions on the accuracy of implant-supported prostheses. J Clin Contemp Pract. 2023 May;5(2):49-56.

8. Kim J, Lee S. Digital impressions and CAD/CAM in prosthodontics. BMC Oral Health. 2024 Mar 8;24(1):207.

9. Jones A. Clinical outcomes of digital versus conventional complete dentures in edentulous patients. J Prosthodont. 2024 Jan;33 Suppl 1:19-35.

10. Singh P, Sharma R. Retention and patient comfort of CAD-CAM fabricated dentures: a systematic review. J Prosthet Dent. 2024 May;33(2):150-60.

11. Chen B, Wang Z. Complete dentures fabricated by 3D printing and milling: a comparative study. J Prosthodont. 2024 Jun;33(4):300-10.

12. Smith E, Brown T. Patient satisfaction and preference with digitally fabricated complete dentures: a pilot study. J Dent Res. 2025 Feb;104(2):210-20.

13. Kaur G, Prasad A. Artificial intelligence in fixed and removable prosthodontics: a review. J Prosthet Dent. 2024 Apr;33(1):50-60.

14. Khan A, Rehman H. AI-assisted digital prosthodontics: evaluation of effectiveness. J Neonatal Surg. 2024 Sep;13(3):321-30.

15. Davies G, Miller P. The role of artificial intelligence in prosthodontics. Oral Surg Oral Med Oral Pathol Oral Radiol. 2024 May;137(5):600-10.

16. Smith J. Review of dental impression materials and techniques. J Dent Res. 2023;102(1):1-10.

17. White A, Green B. Advances in elastomeric materials for complete arch impressions. Dent Mater J. 2024;43(2):150-60.

18. Doe C. Clinical challenges of intraoral scanning in edentulous arches. Int J Prosthodont. 2023;36(5):450-60.

19. Brown D, Davis E. Digital versus conventional impressions: comparing accuracy and efficiency. J Prosthet Dent. 2022;128(3):280-90.

20. Frank F, Gill H. The role of AI in aesthetic and functional denture design. Clin Oral Investig. 2023;27(11):6200-10.

21. Hudson I, Jones K. Simplified digital workflow for complete denture fabrication. J Dent. 2021;115:103750.

22. Lee L, Mason M. Comparative analysis of milled and printed complete dentures. J Adv Prosthodont. 2023;15(1):1-10.

23. Nelson N, Olsen O. Time and accuracy assessment of intraoral scanning for edentulous patients. Clin Oral Investig. 2024;28(3):212.

24. Perez P, Quinn R. Scanning challenges and functional impression techniques for mobile edentulous ridges. J Prosthet Dent. 2023;129(4):500-10.

25. Scott S, Taylor T. Economic factors and initial investment in digital dental technology. Dent Econ. 2022;112(6):35-42.

26. Uhl V, Wolf W. Current perspectives on artificial intelligence in prosthodontic

diagnostics. J Dent. 2024;141:104760.

27. Xavier X, Young Y. CAD software and learning curve in digital denture design. J Prosthodont Res. 2023;67(4):300-10.
28. Zenith Z. The impact of operator skill and learning curve on digital denture fit. Int J Comput Dent. 2024;27(1):50-60.
29. Baker B. Digital workflow implementation in dental laboratories. Dent Today. 2023;42(8):66-70.
30. Carley C. Comparison of milled and 3D printed complete denture bases: accuracy and mechanical properties. J Prosthet Dent. 2023;130(2):200-10.
31. Dupont D. A review of conventional complete denture impression techniques. Gen Dent. 2022;70(3):40-8.
32. Edwards E. Viscosity and detail reproduction in thermoplastic impression compounds. J Dent Res. 2023;102(9):980-90.
33. Foster F. New developments in hybrid elastomeric impression materials. Dent Mater. 2024;40(3):300-10.
34. Gates G. Comparative study on the dimensional accuracy of complete arch impressions. Clin Oral Investig. 2023;27(7):3900-10.
35. Hiller H. Patient preference and satisfaction with CAD/CAM fabricated dentures: a randomized controlled trial. J Prosthodont. 2024;33(5):380-90.
36. Isaac I. Digital dentures and quality of life: speech, mastication, and comfort. J Oral Rehabil. 2023;50(12):1200-10.
37. Jensen J. Factors influencing clinician and student preference for complete denture fabrication methods. J Dent Educ. 2023;87(10):1500-10.
38. Karas K. Evaluating the quality of virtual denture design in CAD/CAM workflows. Int J Prosthodont. 2024;37(2):150-60.
39. Larson L. Artificial intelligence in prosthetic dentistry: design optimization and predictive analytics. J Prosthodont Res. 2024;68(1):1-10.

REGENERATING THE PERIODONTIUM: THE EMERGING ROLE OF STEM CELLS

Abstract

Periodontal disease is a widespread inflammatory condition that destroys the supporting structures of teeth and, if untreated, can lead to tooth loss and systemic complications. Conventional therapies such as scaling and root planing, antibiotics, and surgical procedures mainly control disease progression but fail to achieve complete regeneration of lost tissues. True periodontal regeneration demands the restoration of alveolar bone, cementum , periodontal ligament, and gingival tissues in their original form and function—an outcome not consistently attainable with current modalities. Stem cell biology and tissue engineering have introduced a transformative approach in periodontics. Stem cells possess the ability to self-renew, differentiate into multiple lineages, and modulate immune responses, making them ideal candidates for regeneration. The identification of periodontal ligament stem cells and other dental-derived stem cells has demonstrated remarkable potential to regenerate periodontal tissues under appropriate conditions. Beyond regeneration, their immunomodulatory effects further enhance healing outcomes. Stem cell–based therapies thus mark a paradigm shift in periodontal treatment, moving from repair toward true regeneration. This evolving strategy offers the promise of restoring both function and esthetics, bridging experimental research and clinical application for comprehensive periodontal care.

Keywords: Periodontitis, Periodontal tissue regeneration, Stem cells, Periodontal ligament stem cells

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INTRODUCTION

Periodontal disease is a prevalent oral health condition characterized by inflammation and infection of the structures surrounding the teeth, including the gums, periodontal ligament (PDL), and alveolar bone[1]. This destructive inflammatory process is, in fact, the consequence of an inadequate interaction between the oral microflora and the host defense mechanisms[2]. The consequences of untreated periodontal disease can be severe, ranging from tooth loss to systemic health complications, highlighting the significance of addressing this condition effectively.[3] The ultimate goal of periodontal treatment seeks to preserve the teeth in relatively functional and comfortable good health, and at the same time maintaining the esthetic expectations of the patient. In order to achieve this global objective, a periodontal therapeutic strategy is needed, planned in various phases[2]. Although the existing treatment modalities for periodontal disease, such as scaling and root planning (SRP), antibiotic therapy and surgical interventions like flap surgery and guided tissue regeneration (GTR), have demonstrated varying degrees of success in controlling the progression of the disease[4]. Hence, these approaches often exhibit limitations, including inconsistent outcomes, potential post-operative complications, and an inability to fully restore the damaged periodontal tissues to their original form and functions[5].

The identification of stem cells from human PDL tissues, termed PDL stem cells (PDLSCs), in 2004, led to a new era of research on periodontal regeneration[6]. Today, the use of stem cells is considered as a mainstream strategy for periodontal treatment, particularly for complete regeneration of the periodontal complex, which implies not only the reconstruction of appropriate alveolar bone but also the induction of cementogenesis along the root surfaces with the oriented insertion of newly formed PDL tissue [7]. Stem cells can self-renew and differentiate into multiple cell types and thus have tremendous therapeutic potential. Now a days to accelerate the clinical use of stem cell technology, the mobilization/homing of resident stem cells for regeneration based on endogenous healing mechanisms has become a new concept in regenerative medicine, which is termed as Endogenous regeneration medicine (ERM)[8]. ERM is particularly promising in periodontal research because of the high incidence rate of periodontitis, and mounting evidence indicates that endogenous stem cells can be directed to the periodontium to exert regenerative and immunomodulating functions; this strategy is similar to or more effective than the use of transplanted foreign stem cells[9]. Thus, the goal is to critically examine the advancement of periodontal regeneration, with a particular emphasis on investigating the emerging role of stem cell therapy in periodontal regeneration, as well as to provide available insights into the prospects and challenges of incorporating stem cell-based approaches into clinical practice.

2. MILESTONES IN STEM CELL RESEARCH

- The two zoologists ***Theodor Heinrich Boveri*** (1862-1915) and ***Valentin Häcker*** (1864-1927) used the term stem cell to describe cells committed to give rise to the germline.[10]
- ***Ernst Haeckel*** (1834-1919) called these cells with the aim of regenerating and differentiating themselves **“**stem cells”.[11]
- The oncologist and immunologist ***Georges Mathé*** (1922-2010) in

1958, performed the first successful allogeneic bone marrow transplant with people who are not relatives, and in **1963,** he treated a patient with leukemia for the first time with bone marrow transplant.[12]

- In **1976,** the concept that stem cells may reside in the periodontal tissues was proposed by ***Melcher***, who queried whether the cementoblasts, osteoblasts and fibrioblasts were derived from a single population of ancestral cells or stem cells.[20]
- In **1987**,the studies of ***Mc Culloch et al*** provided the most compelling evidence that stem cells are present within the periodontal tissues.[13]
- In **2003, MIURA et al.** identified the multipotent stem cell [SHED – stem cell from human exfoliated deciduous teeth.[24]
- In **2004** , **SEO et al.** reported multipotent stem cell from human periodontal ligament.[14]
- In **2006**, ***Dr.Irina Kerkis*** reported discovery of Immature Dental Pulp Stem Cells (IDPSC), a pluripotent subpopulation of DPSC using dental pulp organ culture.
- In **2009** – Scientists from Italy announced the first-ever human clinical application using patients' own dental stem cells to repair large mandibular bone defects.
- From ~2018–2023 there was a steady stream of animal studies, small human trials, and meta-analyses indicating **stem-cell therapies (PDL-SCs, DPSCs, BM-MSCs)** can improve clinical attachment levels and bone fill vs. conventional therapy — evidence is promising but heterogeneous and still maturing.
- In a **2025** study, exosomes from dental follicle stem cells that were pretreated with lipopolysaccharide (LPS) promoted regeneration of periodontal tissues in animal models.
- The mechanism involves **miR-184** and activation of the **PPAR*α*-Akt-JNK** signalling cascade, helping regeneration in an inflammatory environment.

3. DEFINITION

"Stem cells also known as "progenitor or precursor" cells are defined as clonogenic cells capable of both self-renewal and multi-lineage differentiation."(Till and McCulloch,1961)15

"Stem cells are unspecialized cells with an extraordinary ability to self -renew, capable of differentiating into one or more specialized cell types playing a crucial role in hemostasis and tissue repair."(Nadig RR ,2009)16

3.1 Characteristics of stem cells

A stem cell has following characteristics (Rodriguez-Lozano FJ et al., 2012)18

• Totipotency- generates all types of cells including germ cells. They are derived from the first few divisions of fertilized egg. These cells can divide into embryonic and extra embryonic cell types.

• Pluripotency- can give rise to every cell of an organism except its extraembryonic tissues such as placenta. This restricts pluripotent stem cells from developing into full organism. Eg., embryonic stem cells, induced pluripotent stem cells. (Fig-1)

• Multipotency- these stem cells are adult stem cells which only generate specific lineages of cells. Eg., hematopoietic stem cells.

• Self renewal- divides without differentiation and creates everlasting supply.

• Plasticity- mesenchymal stem cells have plasticity and can undergo differentiation. The trigger for plasticity are stress or tissue injury which upregulates the stem cells and releases chemo attractants and growth factors.

• Clonogenicity- a stem cell is thought to be clonogenic when it can proliferate to form colony of cells.

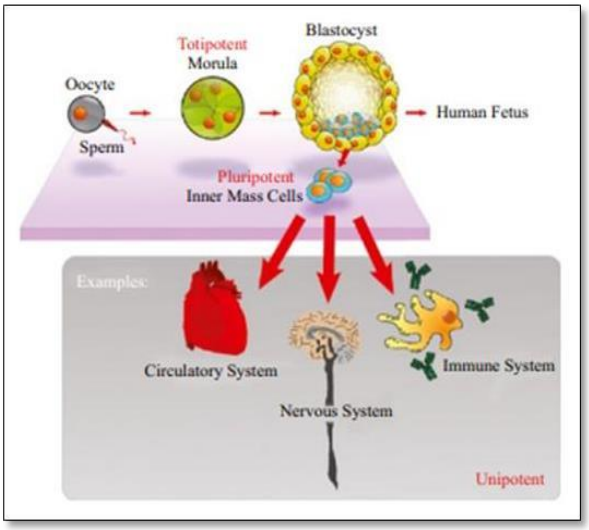

Figure-1: Pluripotent, embryonic stem cells originate as inner mass cells within a blastocyst. The stem cells can become any tissue in the body excluding placentas. Only the morula cells are totipotent and able to become all tissues and placenta.

3.2 Sources and derivation of various dental stem cells-

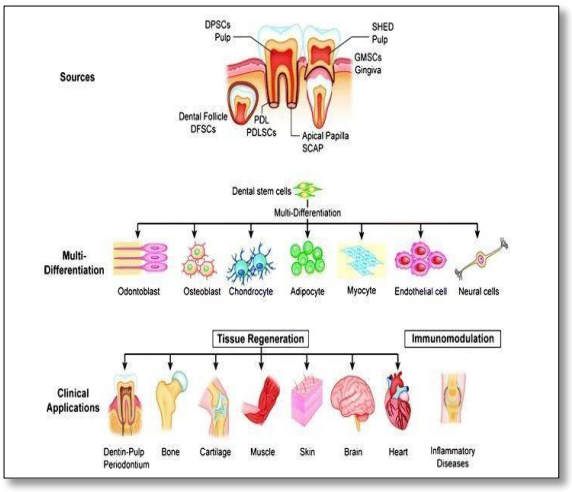

Figure -2: Representing various sources of dental stem cells and their multilineage differentiation capability and potential clinical applications for regenerative and immunomodulatory therapy. DPSCs: dental pulp stem cells ,SHED: stem cells from exfoliated deciduous teeth ,SCAP: stem cells from apical papilla ,PDLSCs: periodontal ligament stem cells ,DFPCs: dental follicle progenitor cells ,GMSCs: gingiva-derived mesenchymal stem/stromal cells

3.3 Classification of stem cells

A) Depending on their differentiating potential [19,20,21,22]

Table-1: Illustrates the classification of stem cells based on their differentiation potential

Type of Stem Cell	Meaning / Origin	Differentiation Potential	Examples
Totipotent / Omnipotent	*Latin: totus* = entire, total	Can generate all embryonic and extraembryonic cell types; can give rise to an entire organism	Zygote (fertilized egg) and cells from its first few divisions
Pluripotent	*Latin: plures* = several, many	Descendants of totipotent cells; can differentiate into cells of all three germ layers but not an entire organism	Embryonic stem cells
Oligopotent		Can form only a few closely related cell types	Lymphoid or myeloid progenitor stem cells
Multipotent		Differentiate into a limited range of cell types within one lineage	Hematopoietic stem cells
Unipotent		Can produce only one cell type but with self-renewal ability	Muscle stem cells

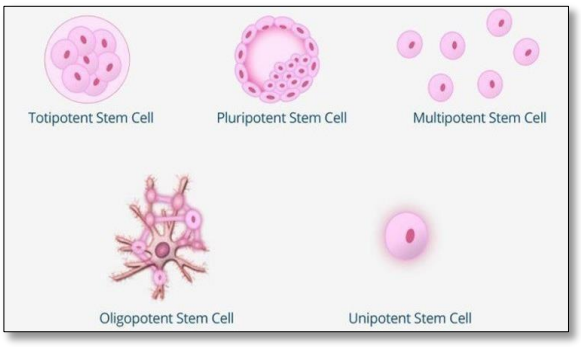

Figure -3: Various types of stem cells according to their diiferentiation potential

B) Based on their origin

Table-2: Illustartes the classification of stem cells based on their origin

Embryonic stem cells	Adult stem cells
Can become all cells of the body. Pleuripotent and totipotent differentiating capacity	Generally limited to differentiating into different cell types of tissue of origin. Mostly multipotent differentiating capacity
Large numbers can be easily grown in culture. Difficult to control proliferation	Rare in mature tissues and method of expanding in cells culture has not yet been worked out
Can cause transplant rejection	Patients own cells can be expanded in culture and reintroduced into the body thus causing no rejection
Virtually immortal. This is due to high expression of telomerase enzyme which is important for maintaining chromosomal stability	Undergo senescence and considered to have a finite life span. Telomerase enzyme absent in most mesenchymal stem cells.

Type of adult stem cells-

Hematopoietic Stem Cells (HSCs)

- Found in: Bone marrow, peripheral blood, umbilical cord blood
- Function: Give rise to all types of blood cells (RBCs, WBCs, platelets)

Mesenchymal Stem Cells (MSCs)

- Found in: Bone marrow, adipose tissue, dental pulp, umbilical cord, synovial fluid
- Function: Differentiate into bone, cartilage, fat, muscle, and stromal cells

Neural Stem Cells (NSCs)

- Found in: Brain and spinal cord (subventricular zone, hippocampus)
- Function: Differentiate into neurons, astrocytes, oligodendrocytes

Epithelial Stem Cells

- Found in: Skin, lining of the gut, cornea
- Function: Regenerate epithelial tissues (skin, lining of organs)

Endothelial Stem/Progenitor Cells

- Found in: Circulating blood and bone marrow
- Function: Contribute to repair and formation of blood vessel

Skeletal Muscle Stem Cells

- Found in: Skeletal muscle fibers
- Function: Differentiate into myoblasts, repair and regenerate muscle tissue

Dental Stem Cells

- Found in: Dental pulp, periodontal ligament, apical papilla, exfoliated deciduous teeth
- Function: Differentiate into dentin, pulp-like tissue, bone, and other connective tissues

Table- 3: Represent the different type of dental stem cells ,their origin and differentiation potential

Type of Dental Stem Cell	Origin	Differentiation potential
Dental Pulp Stem Cells (DPSCs)	Dental pulp of permanent teeth	Differentiate into odontoblasts, osteoblasts, chondrocytes, adipocytes, neurons
Stem Cells from Human Exfoliated Deciduous Teeth (SHEDs)	Pulp of exfoliated deciduous teeth	High proliferation; differentiate into odontoblasts, osteoblasts, adipocytes, neural cells
Periodontal Ligament Stem Cells (PDLSCs)	Periodontal ligament tissue	Differentiate into cementoblasts, osteoblasts, adipocytes, fibroblasts → aid periodontal regeneration
Stem Cells from Apical Papilla (SCAPs)	Apical papilla of developing permanent teeth	Differentiate into odontoblasts, osteoblasts, adipocytes, chondrocytes
Dental Follicle Progenitor Cells (DFPCs)	Dental follicle surrounding unerupted teeth	Differentiate into cementoblasts, osteoblasts, adipocytes, periodontal ligament cells

3.4 _Markers for different dental stem cells[22]

Table -4: Showing markers for different dental stem cells

Dental stem cells	Markers
Embryonic stem cells(ESC)	Oct-4,Nanog, SSEA-3,SSEA-4,TRA-1-60 And TRA-1-81, CD31 Immature dental pulp stem cells also express markers of ESC Transciption factors Oct-4,Nanog and Sox2 form the core regulatory network that ensures the suppression of genes leading to differentiation and maintenance of pluripotency
Hemopoietic stem cells	Highly purified hematopoietic stem cell(HSCs)can be isolated by fluorescence-activated cell sorting with the cell surface markers c-kit thy1.1
Mesenchymal stem cells	STRO-1,Trypsin – resistant cell surface antigen ,is one of the early surface markers of MSCs.It is a commonly used dental stem cell marker for all dental MSCs.
Periodontal ligament stem cells	STRO-1,perivascular cell marker CD 146, alpha smooth muscle actin and pericyte associated antigen

3.5 Methods to identify stem cells

Two methods are nowadays used which include the combination of the chemical properties of fluorescence and unique receptor patterns on cell surfaces to identify specific populations of stem cells-

First method- Fluorescence-activated cell sorting (FACS):

This technique uses a suspension of tagged cells (i.e., bound to the cell surface markers are fluorescent tags) is sent under pressure through a very narrow nozzle so that cells must pass through one at a time. Upon exiting the nozzle, cells then pass, one-by-one, through a light source, usually a laser, and then through an electric field. The fluorescent cells become negatively charged, while non fluorescent cells become positively charged. The charge difference allows stem cells to be separated from other cells. The researchers now have a population of cells that have all of the same marker characteristics, and with these cells they can conduct their research**.**

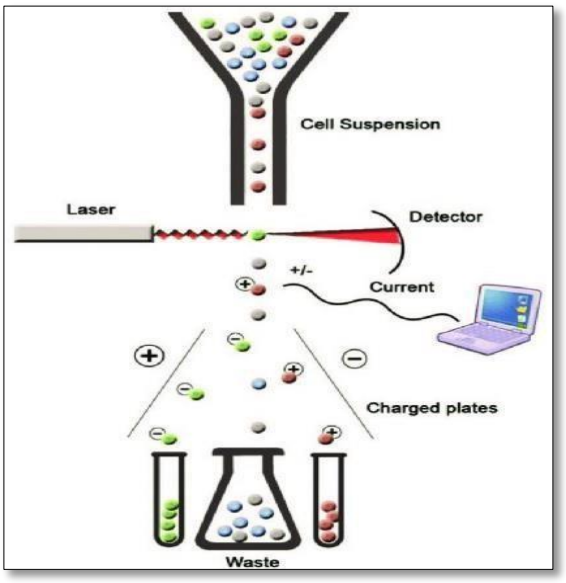

Figure-4: Fluorescence-activated cell sorting (FACS) uses a suspension of tagged cells to identify the stem cells

Second method-

A second method uses stem cell markers and their fluorescent tags to visually assess cells as they exist in tissues. In this method, a thin slice of tissue is prepared, and the stem cell markers are tagged by the signaling molecule that has the fluorescent tag attached. The fluorescent tags are then activated either by special light energy or a chemical reaction. The stem cells will emit a fluorescent light that can easily be seen under the microscope.

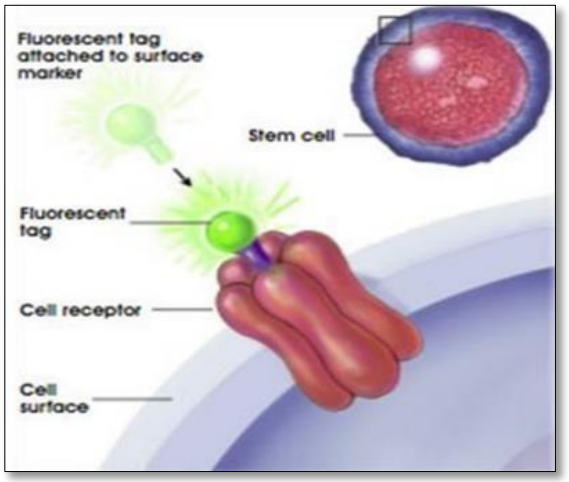

Figure-5: Cell Surface Markers Using Fluorescent Tags to visually assess cells

3.6 Collection , isolation and storage of stem cells

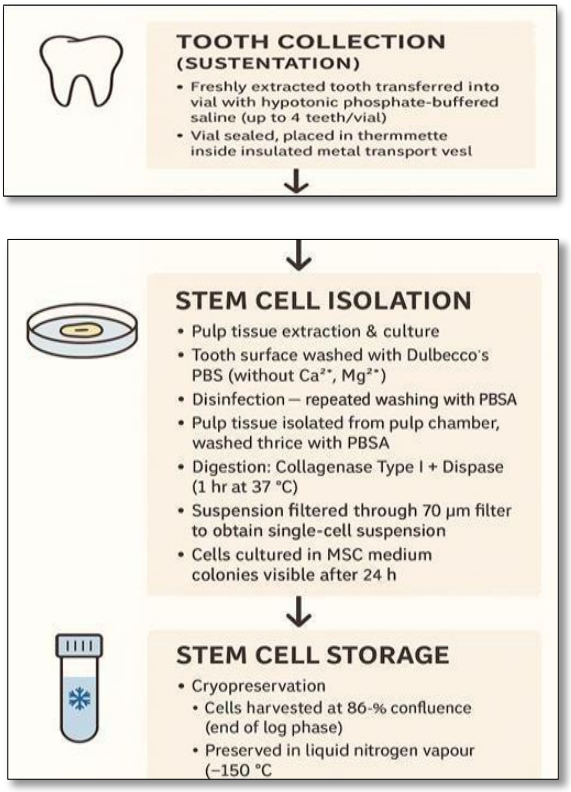

Figure-6: Showing collection,isolation and storage of stem cells

4. ROLE OF STEM CELLS IN PERIODONTOLOGY-

a) Periodontal regeneration

b) Implant site preparation

c) Maxillary sinus lift procedure

d) 3 walled bony defects

e) Bioroot formation

a) Periodontal regeneration- MSC's can regenerate new cementum, alveolar bone and periodontal ligament. Further periodontal ligament cells cultured in vitro where successfully reimplanted into periodontal defects. PDLSC's and DFSC's have become an alternative cell source for periodontal regenerate therapy.

b) Implant site preparation- SHED and DPSC has osteoinductive capacity thus can differentiate into osteoblasts and can promote bone formation.A study was conducted by Yamada Y, Ueda M, Naiki T (2004)23 to regenerate bone in a significant osseous defect with minimal invasiveness and good plasticity. They used a combination of platelet rich plasma as an autologous scaffold with MSCs to increase osteogenesis.

c) Maxillary sinus lift procedure -A study was conducted by Yadollah Soleymani et al. (2008)24, to augment the maxillary sinus using human mesenchymal stem cells loaded into a tricalcium phosphate/ hydroxyapaite scaffold. Use of stem cells can reduce the morbidity introduced by a second surgical site while maintaining equally good implant success rate.

d) 3 walled bony defects- Autologous bone grafts are considered as the best option but it has limited donor sites. Bone tissue engineering endeavours to repair large bone losses using three dimentional scaffolds to deliever vital cells to the defective sites.

e) Bioroot formation -SCAP and PDLSC are currently extensively studied for bio root engineering. Dentin structure regeneration was observed but not enamel. Thus

regeneration of whole tooth structure was not achieved in many cases.

5. CHALLENGES ENCOUNTERED

In view of the gaps and deficiencies in the knowledge of periodontal development and its applications to periodontal therapy, many challenges need to be overcome before stem cell-based treatment can become a clinical reality.

Table-5: Summarizes the biological , technical and clinical challenges encountered during the periodontal stem therapy

Biological	Technical	Clinical
Molecular pathway responsible for stem cell proliferation and differentiation are unknown	Culture mediums are not well developed enough to mimic in vivo conditions to ensure safe and consistent stem cells proliferation and differentition. Stems cell line production for human trials could be hampered by use of xenogenic products in culture mediums as they could be a potential source of pathogens. Mesenchymal stem cells have a limited life span unlike embryonic stem cells which are immortal An ideal biocompatible scaffold and transport mechanism is still under research.	Integration of the human stem cell derivatives with the recipient tissue and their ability to carry out the desired functions in humans is still under speculations.

6. FUTURE PERSPECTIVES OF STEM CELLS IN PERIODONTAL REGENERATION

To overcome some limitation of the present cell therapy and based on the promising results of this animal and human research of stem cells, a further step forward has been proposed by researchers: exogenous human MSCs. Thus far, autologous use of stem cells has been applied only, using an extracted tooth as the source for either PDLSCs or DPSCs. To overcome this limitation, as well as the limitation of the use of stem cells in elderly people, whose regenerative capacity is limited, the use of exogenous or allogenic stem cells has been proposed.[125] Pluripotent stem cells generated from somatic cells (iPSCs) are a possible stem cell lineage to study for periodontal regeneration.[126] They have the potential to differentiate in a spectrum of different cells and tissues.

In dental research, iPSCs-derived mesenchymal cells and osseoprogenitor cells were investigated by scientists with great interest. To be used, these cells need to go through a process of transdifferentiation. In this process, mature somatic cells undergo a transformation to a different somatic cell without going through a pluripotent state or a progenitor phase. This process is also called lineage switching or linage conversion. By means of this process, epigenetic modifications, by directly reprogramming non-osteoblasts cells into functional osteoblasts, have started to be considered as a new therapeutic approach for alveolar bone regeneration. At present, more knowledge for applying these cells to cell-based therapy is needed and preclinical and clinical research will enhance our understanding of these processes.

7. CONCLUSION

The goal of periodontal tissue engineering is to restore the normal function of the diseased periodontium to support the teeth. To achieve this objective, stem cells, appropriate scaffold, and infection control are required at the diseased site. To sum up, stem cell therapies hold out a lot of potential, but there are still a lot of technical challenges that must be cleared through many years of diligent research. The most popular and efficient stem cell types for regenerating periodontal tissue are those produced from bone marrow and periodontal ligaments. The research will aid in the eventual clinical application of stem cell research.

8. REFERENCES

[1] Obulareddy VT, Chava VK, Nagarakanti S: Association of stress, salivary cortisol, and chronic periodontitis: a clinico-biochemical study. Contemp Clin Dent. 2018, 9:299-304.

[2] Alpiste-Illueca FM, Buitrago-Vera P, de Grado-Cabanilles P, Fuenmayor-Fernandez V, Gil-Loscos FJ. Periodontal regeneration in clinical practice. Med Oral Patol Oral Cir Bucal 2006;11:382-92

[3] Klement D. A journey for oral health, WHO, World Global Oral Health Status, and the reality. J of Global Oral Health 2023;11:1-

[4] Chen FM, Jin Y. Periodontal tissue engineering and regeneration: Current approaches and expanding opportunities. Tissue Eng Part B Rev 2010;16:219–255

[5] Liang Y, Luan X, Liu X: Recent advances in periodontal regeneration: A biomaterial perspective . Bioact Mater. 2020, 5:297-308.

[6] Seo BM, Miura M, Gronthos S et al. Investigation of multipotent postnatal stem cells from human periodontal ligament. Lancet 2004;364:149–155.

[7] Chen FM, Jin Y. Periodontal tissue engineering and regeneration: Current approaches and expanding opportunities. Tissue Eng Part B Rev 2010;16:219–255

[8] Yin Y, Li X, He XT et al. Leveraging stem cell homing for therapeutic regeneration. J Dent Res 2017;96:601–609

[9] Kim K, Lee CH, Kim BK et al. Anatomically shaped tooth and periodontal regeneration by cell homing. J Dent Res 2010;89: 842–847

[10] G. Brunetti, A. Di Benedetto, F. Posa et al.,High expression of TRAIL by osteoblastic differentiated dental pulp stem cells affects myeloma cell viability. Oncology Reports 2018;3(4) 2031–2039.

[11] Shalini M, Gajendran P :The Role of Scaffolds in Periodontal Regeneration. Int. J. Pharm. Sci. Rev. Res. 2017;45(1), 135-140

[12] Miura M et al. SHED: stem cells from human exfoliated deciduous teeth. Proc Natl Acad Sci USA 2003; 100:5807-12.

[13] Das D, Karmakar S, Sarkar S, Singh S and Gummaluri SS: Stem cells, regenerative dentistry and their current trends: A narrative review; IJADS 2019; 5(2): 417-425

[14] Fischbach GD, Fischbach RL. Stem cells: Science, policy, and ethics. J Clin Invest 2004;114:1364-70

[15] Nadig RR Stem Cell Therapy-Hype or Hope. J ConserveDent , 2009;12(4), 131-138.

[16] Rodriguez-Lozano FJ, Insausti CL, Iniesta F, Blanquer M, Ramirez MC, Meseguer L,Meseguer-Henarejos AB, Marin N, Martinez S, Moraleda JM. Mesenchymal Dental Stem Cells In Regenerative Dentistry .Med Oral Patol Oral Cir Bucal 2012;17(6) 1062- 1067

[17] Ann A. Kiessling, Scott C. Anderson. Human embryonic stem cells New York;Elsievier, 2010, 26-8

[18] Ferreira L. Stem Cells: A Brief History and Outlook – Science in the News. WordPress 2019

[19] Mitalipov S et al. Totipotency, pluripotency and nuclear reprogramming. Adv. Biochem. Eng. Biotechnol. 2009; 114:185-99

[20] Understanding stem cells - An overview of the science and issues from national academics, 2008