WORLD JOURNAL

OF
DENTAL EXCELLENCE

DAYANANDA SAGAR

100

YEARS

CENTENARY

2021-22

World Journal of Dental Excellence

World Journal of Dental Excellence is an official publication of Dayananda Sagar College of Dental Sciences. It is a Peer-reviewed journal that publishes original papers of the highest quality and scientific content on all the aspects of dentistry to support practice, education, and research. The journal provides a platform to bring out research work and practice oriented skills, and provides the latest information on the advancements in the field. It is published on the website in an electronic format.

The journal accepts original research, systematic review articles/ meta-analysis, case reports, case series, short communication and letter to editor from all the specialities of Dentistry and allied subjects. The journal focuses on cutting edge research, novel and innovative scientific content, specialized area like areas of Artificial Intelligence and genetics.

Standing left to right: Dr. Hemanth M, Principal, DSCDS, Dr. Sanjay Laab, Secretary-IOS, Dr. Balwinder Singh Takkar, President IOS, **Shri.Thawaarchand Gehlot, Honorable Governor, Karnataka**, Dr. D. Hemachandra Sagar, Honorable Chancellor, Dayananda Sagar University, Chairman-DSI, Ms.Tintisha H Sagar, Joint Secretary-DSI, Shri Galiswamy, Secretary, Dayananda Sagar Institutions.

The Propitious Launch of the artistic cover page of the esteemed **World Journal of Dental Excellence** by none other than The Honorable Governor of Karnataka **Shri. THAAWARCHAND GEHLOT** was done at the Prestigious National Training Program in Cleft and Craniofacial Orthodontics at the PC Sagar Auditorium conducted by the Dayananda Sagar College of Dental Sciences in August 2023.

This momentous event was marked by unveiling the cover page that signifies the global reach and impact that the journal embodies along with the representative shades of the Dayanand Sagar group of Institutions with the classic hallmarks of the dental fraternity.

His Excellency expressed his compliments and felicitations on this Landmark occasion and congratulated the Institution on the excellent cover page.

Honorable Late **Shri. Dr. R. Dayananda Sagar**

"EDUCATION COMPLETES A MAN"

Dayananda Sagar College of Dental Sciences & Hospital

Honorable Late Smt Dr. Chandramma Sagar

Our Founder, Late Sri R Dayananda Sagar, was a graduate in Arts & Commerce from India & a barrister-at-law from England. He was a great visionary, an educationist, a powerhouse of knowledge and a believer in transforming the world besides a leader par excellence who saw no reason why, as an Indian, he could not provide education for all sections of society. In setting up Mahatma Gandhi Vidya Peetha Education Trust (MGVP) in the 1960s, Late Shri R Dayananda Sagar also played an important role in the education sector of the emerging India.

The Institution continues to believe in his values that 'Education Completes a Man"

Wife of the founder, Late Smt . Chandramma Sagar was a Doctor by   profession - a Triple FRCS from London, Edinburgh and Glasgow. She was in the panel of Doctors for the President of India.

Dr. D. Hemachandra Sagar
Chairman- Dayananda Sagar Institutions
Chancellor- Dayananda Sagar University

CHAIRMAN'S MESSAGE

I wish to extend my deep appreciation to Dayananda Sagar College of Dental Sciences, Bangalore on the successful launch of World Journal of Dental Excellence.

I am sure the journal you have launched will provide a platform to bring out research work and practice oriented skills, and provides the latest information on the advancements in the field.

It takes a lot of hard work, dedication and efforts to launch a new journal. Your efforts will not only contribute to the advancement of knowledge but also foster collaboration and exchange among experts in the field.

Once again, congratulations on this remarkable achievement and and I am optimistic that it will hold a distinguished place in the scientific literature.

Dr. D. Premachandra Sagar
Vice Chairman - Dayananda Sagar Institutions
Pro Chancellor - Dayananda Sagar University

Dayananda Sagar College of
Dental Sciences & Hospital

VICE CHAIRMAN'S MESSAGE

I wanted to extend my heartfelt congratulations to Dayananda Sagar College of Dental Sciences, Bangalore on the successful launch of World Journal of Dental Excellence. This is truly an exciting endeavour and a significant milestone in the academic journey.

Launching a new journal requires dedication, vision, and a deep commitment to advancing knowledge in the field. Your initiative is commendable and will undoubtedly have a positive impact on the academic community.

I am confident that the Journal will become a valuable resource for researchers, scholars, and practitioners alike, providing a platform for the dissemination of innovative ideas and research findings. May it grow from strength to strength, attracting high-quality submissions and making a lasting impact on the academic landscape.

Once again, congratulations on this tremendous achievement. I look forward to following the journey and witnessing its positive influence in the academic community.

PRINCIPAL'S MESSAGE

Dr. Hemanth M - Principal and Chief Editor

I am thrilled to extend my heartfelt congratulations on the launch of the Official Publication of the Dayananda Sagar College of Dental Sciences, the **World Journal of Dental Excellence.** This is a remarkable achievement and a testament to our dedication, creativity, and hard work.

I believe that it will be a valuable addition to the scientific literature.

As you move forward, may your journal thrive and keep the readers updated about the ideas, opinions, developments and key issues in all disciplines of dentistry

The launch of this journal is a direct result of the dedication and hard work of our editorial team, advisory board, and the many researchers, scholars, and practitioners who have shown an interest in supporting this new venture. We are grateful for their commitment to our vision, and we look forward to collaborating with them as we grow and evolve.

I wish the journal every success and look forward to witness its positive influence in the academic community.

CO - CHIEF EDITOR'S MESSAGE

Dr. Gangaboraiah- Co - Chief Editor

It is with immense excitement and enthusiasm that we officially launch the inaugural issue of World Journal of Dental Excellence. This moment marks a significant milestone in our collective endeavour to foster scholarly excellence. Our mission is to provide a high-quality, peer-reviewed platform for research that advances the boundaries of knowledge and sparks innovation. We aim to publish original contributions that not only reflect the latest developments in Dentistry but also challenge conventional thinking, encourage interdisciplinary approaches, and address the pressing questions of our time.

Table of
CONTENTS

ORIGINAL RESEARCH

CASE REPORTS

REVIEW ARTICLES

AUTHOR GUIDELINES

ORIGINAL RESEARCH

A Comparative Clinical And Radiological Analysis To Correlate The Bone Density And Primary Implant Stability Using Cone Beam Computerized Tomography And Insertion Torque

Shobha ES[1] | Prashanth NT[2] | Vinod Rangan[3] | J Shirisha[4] | Anusha BL[5] |
Alfred Joseph Ravikumar[6]

1 Professor and Head of Department, Department of Oral Implantology, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India.

2 Professor and Head of Department, Department of Oral and Maxillofacial Surgery, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India.

3 Reader, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India.

4,5 Post Graduate Student,Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India.

6 Maxillofacial Surgeon, Bengaluru, Karnataka, India.

Correspondence

Corresponding author Shobha ES

Email: shobhaes@dscds.edu.in

Present address

Department of Oral Implantology, Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 111; Karnataka; India.

Aim / objectives: The aim of this study was to assess the bone quality with density values obtained by cone beam computed tomography (CBCT) and to determine the correlation between bone density and primary stability of implants using insertion torque values.

Materials and methods: Twenty Root Form Implants were inserted into individuals with edentulous areas in upper and lower jaws in whom rehabilitation with implants was possible. The bone densities of implant recipient sites were preoperatively determined by the density value using CBCT. The maximum insertion torque value of each implant was recorded manually using a torque wrench with calibrations. Spearman's correlation coefficient was calculated to evaluate the correlations among density values and insertion torque values.

Results: The density values in Hounsfield units ranged from 209.91 to 667.13Hu. The mean density value and insertion torque of all implants were 464.69 + 135.74 Hu and 49.0 + 8.20 Ncm respectively. There was a highly significant correlation statistically between bone density and insertion torque (rs 0.89, P< 0.001).

Conclusion: The bone density evaluated by CBCT showed a high correlation with the primary stability of the implants (insertion torque). Therefore, the use of a CBCT pre-operatively may greatly help the implant surgeon in predicting the primary implant stability. Hence CBCT can be used as a predictor diagnostic tool for implant success.

KEYWORDS

Cone-Beam Computed Tomography, Dental Implants, Insertion Torque, Primary Stability

1 | INTRODUCTION

The success of a dental implant procedure depends on a series of patient related as well as procedure dependent parameters, including general health conditions, biocompatibility of the implant material, the feature of the implant surface, the surgical procedure and quality and quantity of the local bone.[1] Over the last 10 years, reconstruction with dental implants has changed considerably. Rather than merely focussing on the tooth to be replaced, today's implant practitioner considers a com-plex set of interwoven factors before formulating an implant treatment plan.[2] The success of a dental implant relies majorly on both the quality and quantity of the bone available for implant placement.[3] Bone density is a key factor to take into account the prediction of implant stability.[4]

Bone density plays a pivotal role, influencing implant stability, particularly in the mandible compared to the upper maxilla.[5] Misch (2008) used computed tomography (CT) to objectively classify bone density into 5 types based on Hounsefield units (HU). Various imaging tech-niques, including computed tomography (CT) and cone-beam computed tomography (CBCT), are employed for presurgical and postsurgical ex-aminations, offering 3D perspectives crucial for assessing bone quality.[6] CBCTs are increasingly being considered essential for optimal implant placement, especially in the case of complex reconstructions.[7] The cone beam configuration is ideal for the maxillofacial region be-cause the dimensions of the beam allow for a panoramic view, sparing patients the radiation exposure of separate scans of the maxilla and mandible.[8] The past two decades have seen continual efforts by manu-facturers, researchers and clinicians to improve the success of implant treatment outcomes through evaluation in implant designs, materials and clinical procedures.[9] One such aspect is corelation of available bone density with primary implant stability.

Primary implant stability, referring to immediate stability post-implantation, is a critical factor in the osseointegration process. Eval-uation methods like insertion torque tests and resonance frequency analysis provide non-invasive insights into local bone quality, guiding decisions on immediate loading with prosthetic reconstruction.

Several studies have explored the correlation between bone density, as assessed by CT or CBCT, and primary implant stability. Notably, a study by Isoda et al. demonstrated a strong correlation between specific CBCT-evaluated bone quality and primary implant stability.

This study aims to contribute to this body of knowledge by comparing CBCT-estimated bone density with primary implant stability, using insertion torque measurements. Understanding this relationship enhances the predictability of implant treatment outcomes, facilitating more informed decision-making in clinical practice.

2 | AIMS AND OBJECTIVES

To assess the bone quality with density values obtained by cone beam computed tomography (CBCT) and to determine the correlation between bone density and primary stability of implant by insertion torque value.

3 | MATERIALS METHODS

The study was done to compare and correlate clinically and radiologi-cally the bone density and primary implant stability using cone beam computerized tomography and insertion torque, on patients who visited the Department of Oral Maxillofacial Surgery, Dayananda Sagar College of Dental Sciences, Bangalore for implant supported prosthetic rehabili-tation. Twenty out- patients with missing single/ multiple teeth and who were suitable for implant rehabilitation were considered for the study.

INCLUSION CRITERIA:

• 20 healthy individuals with edentulous areas in upper and lower

jaws in whom rehabilitation with implants was possible were taken up for the study. • Patients with missing single/ multiple teeth for implant replacement.

EXCLUSION CRITERIA:

• Patients with uncontrolled systemic/ psychiatric illness. • Patients with previous history of/ undergoing radiotherapy or chemotherapy • Pregnant patients • Clinical cases of post implant removal • Implants placed in sinus lift and immediate extraction sites.

PRE-OPERATIVE ASSESSMENT:

• Patients selected from the above criteria were evaluated and recorded on a custom made Case sheet. (Performa Attached)

• A written informed consent was obtained from all patients and a standardized pre-surgical and surgical protocol was followed for all the patients.

• Pre-operative bone density of implant sites was evaluated using cone beam computerized tomographic scans.

• Bone density measurements were derived using 3DiagnoSys version 4.1 Software It is a licensed product from 3DIEMME Bio imaging Technologies. 3DiagnoSys® is a diagnostic imaging, analyses and 3D simulation software, tailored for the Clinician. 3Diagnosys® software helps to interact with the 3D-model of the Patient, which is obtained by importing TC/CBCT/RM images in DICOM format, in a simple and intuitive way. The tools included in this software are not bound to a mor-phological reconstructions but are also able to extract from the DICOM data the densitometric values for a bone functional evaluation.)

• Pre-operative evaluation of bone height and bone width was done using Cone Beam Computed Tomographic scan and appropriate implants were selected to be placed.

• The bone height and width measurements were achieved using the "Carestream Dental Imaging Software v6.13.3.3 CS imaging software" (Fov-15x9cm)"

• All CBCT scans were obtained using the "KODAK 9500machine" (10ma 90 Kvp, 200-micron resolution, 10.9sec exposure, 605mgy per cm2).

SURGICAL PROCEDURE OF IMPLANT PLACEMENT:

1. In all instances, implants were placed under local anaesthesia using
2. 2 Different implant systems were used and all were root form implants.
3. Surgical preparation and isolation of surgical field was accomplished according to standard operative protocols.
4. Surgical template pre-pared on the model pre-operatively was used to identify the implant placement site.
5. A Crestal incision was placed with a No.15 BP blade.
6. Mucoperiosteal flap was reflected and alveolar bone was exposed, and the implant placement site was identified by the marking made with the aid of the surgical probe.
7. Osteotomy site preparation was done with a Reduction gear hand piece (1:16/64) with an external irrigation attached to the handpiece.
8. Implant osteotomy was performed using standard sequential drill bits as per the dimensions of the implant.
9. A speed of 800 RPM and torque of 25-30 ncm was standardized for the procedure.
10. The osteotomy was proceeded till the desired depth as per the selected implants.(Fig:15, 16, 17)
11. The orientation of the os-teotomy was verified using paralleling pins when placing two or more implants, using the long axis of the adjacent teeth as a reference plane.
12. The implant was inserted into the osteotomy site with the use of a manual torque wrench until the final depth was achieved(Fig 18,19, 20).
13. All Implants placed were of tapered design and their lengths ranging from8 to 16 mm and diameters from 3-5 mm.
14. Following the placement of the implant, its stability was assessed manually using the insertion torque test with a calibrated torque wrench.
15. The insertion torque reading was measured and recorded at the maximum torque re-sistance achieved.
16. The cover screw over the implant was then placed.
17. Flap closure was done using 3-0 vicryl.

RADIOLOGICAL ASSESSMENT:

Post-operative OPG and IOPA was taken.

POST OPERATIVE PROCEDURE:

1. Routine Antibiotics and anti-inflammatory drugs were prescribed along with oral hygiene maintenance instructions.

2. Patients were re-called for regular follow ups.

3. Permanent prosthesis was given after 3 month
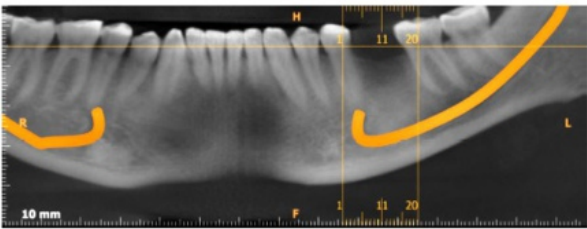
Fig:1 Height Measurements Scale: 1-20; Slice Thickness – 0.2mm; Section Thickness – 1mm; Implant site: 9-12
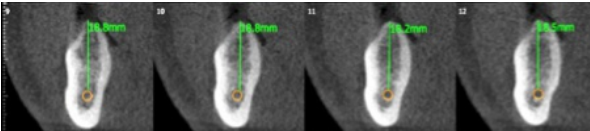
Fig: 2
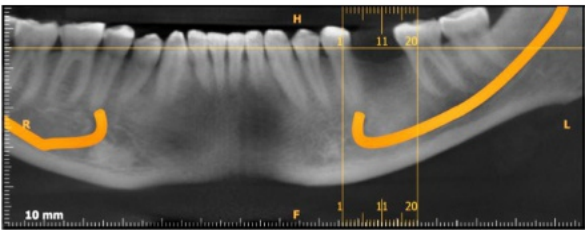
Fig: 3: Width Measurements Scale: 1-20, Implant site:9-12
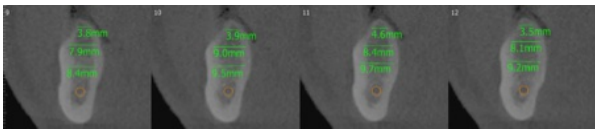
Fig:4
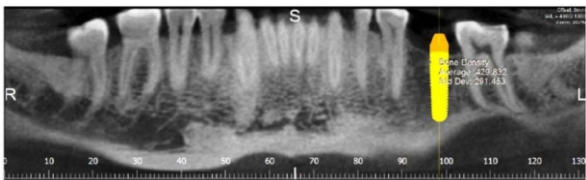
Fig:5: Pre-Operative Bone Density measurements taken using 3Diagnosis Software V4.1

Fig:6

Fig:7

Table 2. Age distribution of study population

	Mean	Standard Deviation	Range
Age (years)	36.45	11.96	19-59

Table 3 . Gender distribution of study population
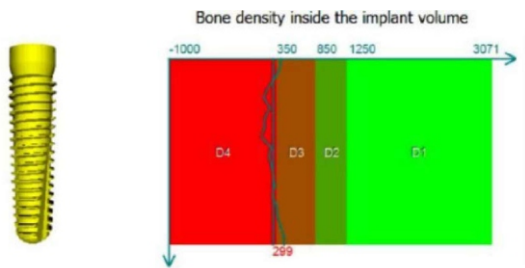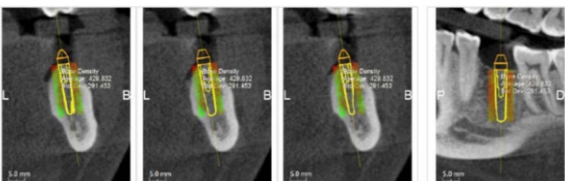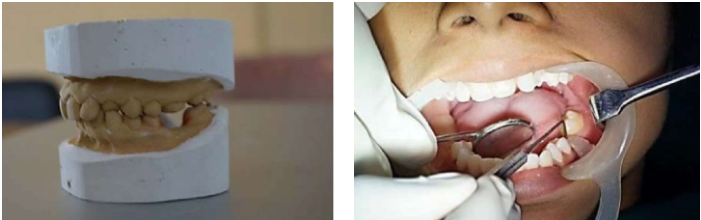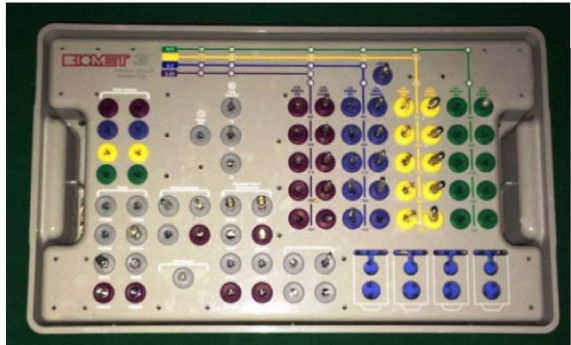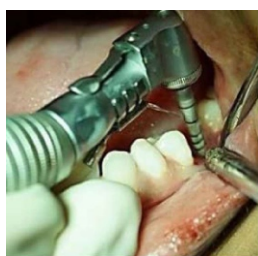
	Number	Percentage
Male	7	35
Female	13	65

Table 4. Mean values of bone density and insertion torque

	Mean	Standard Deviation	Range
Bone density (Hu)	464.69	135.74	209.91-667.13
Insertion torque (Ncm)	49.0	8.20	40-60

Table 5. Correlation between bone density and insertion torque

	Insertion torque (Ncm)	P value
Bone density (Hu)	0.89	<0.001 **

Spearmans correlation test

** P<0.001 highly significant

Fig 1. Gender distribution of study population

Fig 2. Scatter plot for correlation between bone density and insertion torque

4 | STATISTICS & RESULTS

The statistical analyses were performed using SPSS version 16.0 software (SPSS Inc., Tokyo, Japan). Spearman's correlation coefficient (rs) was calculated to evaluate the correlation among density values and insertion torques. A value of $P < 0.05$ was considered to be statistically significant.

RESULTS

The density value ranged from 209.91 to 667.13 hU. The mean density value and insertion torque of all implants were 464.69 + 135.74 Hu and 49.0 + 8.20 respectively. There was highly significant correlation between bone density and insertion torque (rs 0.89, P< 0.001).

5 | DISCUSSION

Preoperative evaluation of the bone quality is important for the clinician to establish an optimum treatment plan for implant supported dental rehabilitation. Accurate information and assessment of the bone density will help the surgeon to identify suitable implant sites and determine accurate implant designs.[1] A precise evaluation of the bone configuration is essential prior to implant placement.[1] One of the most important factors in determining implant success is proper treatment planning and with the advent of advanced imaging technology, Cone Beam Computerized Tomography (CBCT) is increasingly being considered as an essential tool determining the bone quality and quantity thus helping for optimal implant planning and placement.[2]

Presurgical dental implant planning for Implant placement requires specific and accurate data to assess the implant site so that the dental implants placed has the greatest chance of success.[3] It has been proven that the success of an inserted implant strongly depends on the quality, beside the quantity, of the surrounding bone (Jaffin & Berman 1991; Jemt et al. 1992).[4]

Various bone classification systems have been proposed to assess bone quality. In 1985, Lekholm and Zarb introduced a system that uses radiographs to subjectively classify bone density into four types based on the proportions of cortical and trabecular bone. This classification has gained worldwide use due to its simplicity and minimal investment requirements. Misch (2008) developed a classification system using computed tomography (CT) to objectively categorize bone density into five types based on Hounsfield units (HU) (Hounsfield 1980). This method provides a precise and objective evaluation of bone quality.[1]

Lekholm and Zarb used radiographs to subjectively classify bone density into four types based on the amount of cortical and trabecular bone. This classification system has been utilized Worldwide because it is easy to use without considerable investment. Misch (2008) used computed tomography (CT) to objectively classify bone density into 5 types based on Hounsfield units (HU) (Hounsfield 1980). This method allows for a precise and objective assessment of bone quality.[1]

Significant correlations between the density values of CBCT and Hounsfield unit (HU) of multi slice CT were also reported in recent studies (Naitoh et al. 2009; Nomura et al. 2010). In a recent study, Pauwels et al. (2013) investigated the correlations between CBCT derived gray values and multi slice CT-derived gray values. The authors found controversial results showing good correlations between CBCT and CT but also large errors when using gray values in a quantitative way. Consequently, deriving bone density values from CBCT images seems controversial. In the literature, there are only limited number of studies about the correlation between bone density estimated by CBCT and primary implant stability.[6]

Primary stability is associated with the mechanical engagement of an implant with the surrounding bone. Whereas bone regeneration and remodelling phenomena determine the secondary (biological) stability to the implant. A secure primary stability is positively associated with a secondary stability.[7]

In the present study 20 healthy individuals, who visited the Department of Oral & Maxillofacial Surgery, Dayananda Sagar College of Dental Sciences, Bangalore for implant supported prosthetic rehabilitation were taken up.

Helical CT scans provide bone density measurements in HU. In contrast, CBCT lacks a standardized unit like HU because it has not been calibrated. Several studies have found a high correlation between CBCT density values and the HU of multi-slice CT (Aranyarachkul et al. 2005; Naitoh et al. 2009; Nomura et al. 2010). Radiographic examinations can offer preoperative bone density information. HU is a standardized scale used for reporting reconstructed CT values (Shapurian et al. 2006).

In a previous study, 32 helical CT scans of patients were examined, revealing mean bone density values ranging from 77 to 1421 (Norton & Gamble 2001). Bone density values from 20 patients evaluated via CBCT ranged from 238 to 777 (Song et al. 2009). Additionally, the bone density values of three human mandibles (dry bone) varied between 267 and 553 HU, with a mean of 113 HU (Turkyilmaz et al. 2009). The density values recorded in the present study are comparable to those reported in these studies and can be considered analogous to HU values assessed by helical CT. In our study, density values ranged from 209.91 to 667.13 HU, with a mean density value of 464.69 ± 135.74 HU for all implants.

The study reveals a robust correlation (0.89) between Cone Beam Computed Tomography (CBCT)-derived bone density and implant stability, endorsing CBCT as a valuable tool for preoperative assessment. Previous research also indicates correlations between bone density and implant stability. However, conflicting results exist, with some studies showing no correlations. The present clinical study emphasizes the importance of including cortical bone evaluation in preoperative bone density assessments. CBCT examinations before implant surgery prove instrumental in predicting primary stability, guiding optimal loading times for implants in prosthetic rehabilitation. While CBCT shows promise, further research is essential to explore correlations across diverse variables influencing implant stability.

5 | CONCLUSION

In the study conducted in the Department of Oral and Maxillofacial surgery, Dayananda Sagar College of Dental Sciences, we aimed to evaluate bone quality by using density values obtained from cone beam computed tomography (CBCT) pre-operatively and to determine their correlation with insertion torque values recorded during the implant placement procedure.

Based on the observations and results obtained, we can conclude that this study demonstrates the relationship between bone density values derived from Cone Beam Computed Tomography (Hu) in the maxilla and mandible and bone quality as classified by Lekholm & Zarb.

The primary implant stability measured with the insertion torque test (ITV) depends on bone density values, bone quality and implant location. Implants Placed in location with higher bone density have more stability, and we can probably predict the implant insertion torque based on the bone density values (Hu) and the implant location. Finally, with higher bone density values (Hu) and higher primary implant stability measured in ITV values; Hounsfield units can be used as a diagnostic parameter to predict possible implant stability.

CONFLICT OF INTEREST:

The authors declare no conflict of interest.

REFERENCES:

1. Gulsahi A, Turkyilmaz I, Bone Quality Assessment for Dental Implants, Implant Dentistry - The Most Promising Discipline of Dentistry2011,ISBN: 978-953-307-4818. InTech, Available from: http://www.intechopen.com/books/implant-dentistry-the mostpromising-discipline-of-dentistry/bone-qualityassessment-for-dental-implants.

2. Misch C, Dental Implant Prosthetics, 1st edition.

3. Isoda K, Ayukawa Y, Tsukiyama Y, Sogo M, Matsushita Y, Koyano K. Relationship between the bone density estimated by cone-beam computed tomography and the primary stability of dental implants. Clin. Oral Impl. Res. 23, 2012; 832–836.

4. Farré-Pagés N, Augé-Castro ML, Alaejos-Algarra F, Mareque-Bueno J, Ferrés-Padró E, Hernández-Alfaro F. Relation between bone density and primary implant stability. Med Oral Patol Oral Cir Bucal. 2011 Jan 1;16 (1):e62-7.

5. Babbush CA, Hahn JA, Krauser T, Rosenlicht J, Dental Implants; The Art and Science, 2nd edition, pg110-123.

6. Siu, Chu, Li et al, Imaging modalities for preoperative assessment in dental implant therapy: an overview, Hong Kong Dent J. 2010;7(1):23-30.

7. Lingeshwar D, Dhanasekar B, Aparna IN, Diagnostic Imaging in Implant Dentistry, Int J Oral Implantol Clin Res. 2010;1(3):147-153.

8. Parel S, Triplett G, Interactive imaging for Implant Planning, Placement and Prosthesis Construction, J Oral Maxillofac Surg 2004;62(2):41-47.

9. Piao C M,Heo S J,Koak J Y,Kim S K,Han C H,Fang X H,Effect of Implant designs on insertion torque and implant stability quotient value,J Korean Acad Prosthodont, 2006;44(3):325-332.

10. Melzer A M,Primary Implant stability and Initial bone-to-implant contact:The effects on immediate placement and restoration of dental Implants,Journal of Implant and Reconstructive Dentistry 2009;1(1).

11. Hedesiu M, Vicas A, Baciut G, Jacobs R & Nackaerts O (2010) "CBCT bone quantification for preoperative planning of oral implant placement" presented at the 12th European Congress of Dento-Maxillo Facial Radiology, 2 - 5 June 2010, Istanbul, Turkey.

12. F. Ebrahim, D. Iaboni, T. Kwon, J. Sekoulidis, L. Caulley, & I. Zajaczkowski. Cone Beam CT For Preoperative Dental Implant Site Assessment: An Evidence-Based Review of the Literature University of Toronto, Faculty of Dentistry.

13. Trisi P, Perfetti G, Baldoni E, Berardi D, Colagiovanni M, Scogna G. Implant micromotion is related to peak insertion torque and bone density. Clin. Oral Impl. Res. 20, 2009; 467–471. doi: 10.1111/j.1600-0501.2008.01679.x.

14. Turkyilmaz* I, McGlumphy E A : Influence of bone density on implant stability parameters and implant success: a retrospective clinical study . BMC Oral Health 2008, 8:32 doi:10.1186/1472-6831-8-32 http://www.biomedcentral.com/1472-6831/8/32.

15. Parsa A, Ibrahim N, Hassan B, van der Stelt P, Wismeijer D. Bone quality evaluation at dental implant site using multislice CT, micro-CT and cone beam CT. Clin. Oral Impl. Res. 00, 2013, 1–7 doi: 10.1111/clr.12315.

16. Cavallaro J, Greenstein B and Gary G: Clinical Methodologies for Achieving Primary Dental Implant Stability The Effects of Alveolar Bone Density. J Am Dent Assoc 2009;140;1366-1372.

17. Norton M R:The influence of insertion torque on the survival of immediately placed and restored single-tooth implants. INT J Oral Maxillofac Implants 2011.

18. Sennerby L, Andersson P, Pagliani L, Giani C, Moretti G, Molinari M,Motroni A, Evaluation of a Novel Cone Beam Computed Tomography Scanner for Bone Density Examinations in Preoperative 3D Reconstructions and Correlation with Primary Implant Stability : Clinical Implant Dentistry and Related Research, Volume *, Number *, 2013.

19. Salimov F, Tatli U, K€urkc_€u M, Ako_glan M, € Oztunc_ H, Kurto_glu C. Evaluation of relationship between preoperative bone density values derived from cone beam computed tomography and implant stability parameters: a clinical study. Clin. Oral Impl. Res. 00, 2013, 1–6 doi: 10.1111/clr.12219.

20. Bayarchimeg D, Namgoong H, Kim B K, Kim M D, Kim S, Kim T I, Seol1 Y J, Lee Y M, Ku1 Y, Rhyu1 I C, Lee E H, Koo1 K T: Evaluation of the correlation between insertion torque and primary stability of dental implants using a block bone test: J Periodontal Implant Sci 2013;43:30 http://dx.doi.org/10.5051/jpis.2013.43.1.30.

21. Cassetta M, Stefanelli L V, Pacifici A, Pacifici L, Barbato EIs CBCT Accurate in Measuring Bone Density? A Comparative CBCT-CT In Vitro Study C, Clinical Implant Dentistry and Related Research, Volume *, Number *, 2013.

22. Lee S , Gantes B, Riggs M, Crigger M.Bone density assessments of dental implant sites Bone quality evaluation during osteotomy and implant placement. Int J Oral Maxillofac Implants. 2007 Mar-Apr;22(2):208-12.

23. Clinical Outcome of Dental Implants Placed with High Insertion Torques (Up to 176 Ncm) Khayat P G, Arnal H M, Tourbah B I, Sennerby L, Clinical Implant Dentistry and Related Research, Volume *, Number *, 2011.

24. The effect of implant design on insertion torque and immediate micromotion. www.bioportfolio.com/resources/pmarticle/159934/The-effect-of-implant-design-oninsertion-torque-and-immediate-micromotion.html

25. Grandi T, Garuti G , Guazzi P, Sapio U, Forabosco A, A longitudinal, multicentre study on the relationship between insertion torque and peri-implant bone resorption. Journal of clinical &practical oral implantology volume 1 issue 2.

26. Aranyarachkul, P., Caruso, J., Gantes, B., Schulz, E., Riggs, M., Dus, I., Yamada, J.M. & Crigger, M. (2005) Bone density assessments of dental implant sites: 2. Quantitative cone-beam computerized tomography. The International Journal of Oral & Maxillofacial Implants 20: 416–424.

27. Bergkvist, Göran / Koh, Kwang-Joon / Sahlholm, Sten / Klintström, Eva / Lindh, Christina: Bone Density at Implant Sites and Its Relationship to Assessment of Bone Quality and Treatment Outcome: Int J O ral Maxillofac Im plants 25 (2010), No. 2 (15.03.2010).

28. Pagliani L, Sennerby L, Andersson P, Verrocch D , Meredith N: Insertion Torque Measurements During Placement of Neoss Implants; Applied Osseointegration Research Vol 6, 2008.

29. Marquezan M, Oso´ rio A, Sant'Anna E, Souza MM, Maia L, Does bone mineral density influence the primary stability of dental implants? A systematic review. Clin. Oral Impl. Res. 23, 2012; 767–774. doi: 10.1111/j.1600-0501.2011.02228.x

30. Monje A, Suarez F, Garaicoa C A, Monje F, Galindo-Moreno P, García-Nogales A, Wang H L, Effect of Location on Primary Stability and Healing of Dental Implants: IMPLANT DENTISTRY / VOLUME 0, NUMBER 0 2013.

Comparative Evaluation of Microleakage in Class II Cavities Restored with Snow Plow Technique Using Different Flowable Composite Resins as Gingival Increment Followed by Packable Composite Resin Restorations – An In-Vitro Dye Extraction Study

Ranjini MA[1] | Geetha V[2] | Vedavathi B[3] | Ashok HK[4] | Deepthi M[5] | Swathi S[6]

[1] Reader, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[2,6] Postgraduate, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[3] Professor and Head, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[4] Reader, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[5] Senior Lecturer, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

Correspondence
Corresponding author Ranjini MA
Email: ranjinima@dscds.edu.in

Present address
Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 111; Karnataka; India.

Abstract

To evaluate and compare microleakage in class II cavities restored with snow plow technique using two different flowable composite resins as gingival increment followed by packable composite resin restorations. Fifty sound first molars free of caries, cracks, decay and restorations were selected for this study. Class II mesio occlusal box preparations were made with the following dimensions, buccolingually-3mm, mesiodistally-2mm. The gingival margin was placed 1mm above CEJ. The test specimens were randomly divided into two groups for restoration. GROUP 1: Tetric N Flow bulk fill and Tetric N Ceram bulk fill co cured in snow plow technique. Group 2: SDR plus bulk fill and Tetric N Ceram bulk fill co cured in snow plow technique. Restored teeth were thermocycled for 500 cycles between 5° C and 55° C. The radicular apices of teeth were sealed the teeth were covered with nail varnish completely, except for 1-2 mm around the margins of restorations. The samples were immersed in 2% methylene blue dye for 24 hours, washed and processed for dye extraction. Sample absorbance value was read by UV visible spectrophotometer at 550 nm. Statistical analysis was done using SPSS software and Mann-Whitney U test. Results showed lower microleakage in SDR plus group (median of 0.0398) compared to Tetric N flow bulk fill group (median of 0.05890) and the difference between them was statistically significant. The present study concluded that SDR plus bulk fill restoration of class II cavities in snow plow technique showed lower microleakage compared to Tetric N flow bulk fill composite resin in snow plow technique.

KEYWORDS
Snow plow, SDR plus, Bulk fill, Microleakage, Dye extraction

1 | INTRODUCTION

Dental composite resins have advanced tremendously to become the most preferred material for direct restorations in both anterior and pos-terior teeth. The restoration of natural contour of tooth, proximal con-tacts as well as sealing of the margins is of critical importance. Despite having good physical and mechanical properties, the main reason for failure of these restorations is the recurrence of caries. Achieving a com-plete and durable marginal seal in direct composite resin restorations, particularly in class II cavities still poses a challenge.[1] Polymerization shrinkage associated with these materials generates stresses that can damage the bond of the resin composites to the cavity walls, which produces microleakage allowing bacteria and fluids to move via the tooth-restoration interface.[2] This marginal microleakage can produce recurrent caries, hypersensitivity, discolorations, and pulpal lesions, among others.[3]

Polymerization shrinkage in composite resin is governed by vari-ous factors, some of which are under the manufacturer's control while others are under the clinician's control. Factors under manufacturers control include type and amount of resin matrix, type and amount of the filler and photo activator system used. Factors under clinicians control include using various techniques such as different incremental place-ment techniques, using low modulus of elasticity material as the first increment, placing thicker adhesive layers under composites, using fiber inserts and use of various light curing methods such as ramp curing and pulse curing.[4]

One of the most important factors in the reduction in shrinkage stresses in class II cavities, is the restoration placement techniques. Although incremental technique may be important for adequate light penetration, its disadvantages are the possibility of trapping voids between layers and the formation of oxygen inhibition layer at the sur-face of the cured layer. Among the placement techniques, application of resin composite in bulk increments of up to 4mm has the advan-tages of reduced treatment time by reducing the number of increments, enhanced depth of cure owing to the addition of specialized fillers and photo initiators, and reduction in the number of voids.[5]

The recently developed bulk Fill composite resins possess spe-cific characteristics, enabling them to adapt efficiently to the cavity preparation.[6] However in deep class II preparations, marginal adapta-tion and flow is questionable even with bulk fill resins. To overcome these challenges in class II cavity restorations, snow plow technique was introduced, in which a less viscous material is applied as gingival incre-ment, overlayed by packable bulk fill composite resin and both materials together are co cured.[7] Subsequently, rest of the preparation is com-pleted with packable bulk fill composite resin. This technique has the advantages that the more viscous superficial composite helps in bet-ter flow and adaptation of flowable material, better bonding to unset subsequent increment and allows the flowable material to behave as a stress absorber.[8]

SDR plus bulk fill composite resin was developed with a Stress Decreasing Resin (SDR™) technology. It enables bulk-fill up to 4mm instead of placing and curing multiple composite layers in Class I and II restorations. It is indicated to be overlayed with a methacrylate-based universal composite for replacing missing occlusal/facial enamel.

The SDR technology is a patented urethane Di methacrylate structure that is responsible for the reduction in polymerization shrinkage and stress.[9] SDR has minimal overall shrinkage 3.5% compared to other con-ventional flowable composites. Lower volumetric shrinkage contributes to overall lower polymerization stress. It also exhibits self levelling technology that promotes excellent cavity adaptation.[10]

Tetric N-Ceram Bulk Fill and Tetric N-Flow Bulk Fill can be applied in "bulk" increments of up to 4 mm as they contain the new light initia-tor called Ivocerin.[11] As a result of its higher photo-reactivity compared with the initiators contained in other bulk-fill materials, the opacity of the composite resin is also slightly higher. Hence, polymerization is initi-ated even in very deep cavities and the material is fully cured. It contains an isofiller, a specially conditioned shrinkage stress reliever with a low modulus of elasticity that attenuates the forces generated during shrink-age and thereby keeps shrinkage and stress during polymerization to a minimum.[12]

The curing shrinkage and its associated stress may be greater for a flowable composite, due to the typically lower filler content, and pre-curing of this liner produces stresses that may compromise its adap-tation and sealing of the margins. The composite placement technique in snow plow method ensures that the flowable material is "pushed" into a highly thin layer that is simultaneously cured with the conventional composite, the negative effects of shrinkage of a relatively thick layer of flowable is potentially negated.

A search on literature is limited regarding evaluation of microleak-age in class 2 cavities restored with SDR plus bulk fill and Tetric N flow bulk fill composite resin as initial increment in snow plow technique. Hence the current study evaluated microleakage in class 2 prepara-tions restored with SDR plus bulk fill and Tetric N flow bulk fill as initial increment with Tetric N ceram bulk fill composite resin in snow plow technique.

2 | METHODOLOGY

50 extracted mandibular molars free of caries, cracks, decay and restorations were selected for this study. All the selected teeth were stored in 0.5% chloramine T solution for 12 hours, and then washed and transferred to 0.9% saline solution. Standardized class II mesio occlusal box preparations were made with following dimensions - 3mm buccolingually and 2mm mesiodistally. Gingival seat of the proximal box was placed 1 mm above cementoenamel junction. The samples were randomly assigned into two groups of 25 teeth in each group for restorations. Samples of each group were mounted in contact with each other, Tofflemire matrix band and retainer was adapted to establish contact and restored as follows:

GROUP 1 – Flowable bulk fill (Tetric N Flow) and packable bulk fill composite resin (Tetric N Ceram) in snow plow technique. Restoration completed with packable bulk fill composite resin.

GROUP 2 – Flowable bulk fill (SDR plus) and packable bulk fill composite resin (Tetric N Ceram) in snow plow technique. Restorations were completed with packable bulk fill composite resin.

All restorations were finished and polished with soflex discs and points.

The samples were then stored in distilled water for 24 hours at 37 °C and then thermo-cycled for 500 cycles with dwelling time of 30 seconds and transfer time of 5 seconds, between 5°C and 55 °C. For microleakage assessment, the radicular apices of teeth were sealed with sticky wax and root and crown surfaces of the teeth were completely covered with nail varnish except for 1-2 mm around the margins of restorations. Specimens were then immersed in 2% methylene blue dye for 24 hours. After 24 hours, the samples were washed under tap water to remove the traces of the dye. The nail varnish was removed using polishing discs.

The teeth were placed in test-tubes containing 3 ml of 65 wt % nitric acid for 3 days. Test-tubes were centrifuged at 5,000 rpm for 5 mins. Supernatant from each sample was transferred to cuvettes. The dye absorbance was measured in a UV visible spectrophotometer at 550nm.

The results of the spectrophotometer indicate the dye absorbance of methylene blue in resin-dentin interface which indicates the microleakage of restoration. The results obtained were statistically analyzed and evaluated.
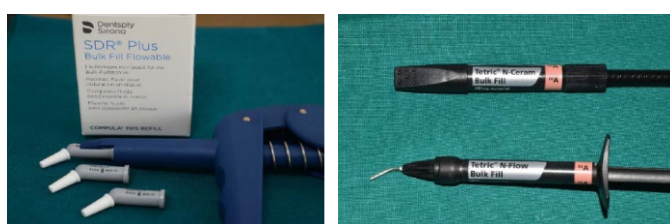

Fig 1 SDR plus and Tetric N Ceram bulk fill composite resins

Fig 2 Standardized class II mesio-occlusal box preparation

Fig 3 UV Spectrophotometer

3 | RESULTS

Data showed non-normal distribution, hence non-parametric test (Mann-Whitney U test) was applied. In this study, the microleakage score in teeth restored with group I & II were (IQR 0.0129) & (IQR 0.0116) respectively.

Mann-Whitney U test showed statistically significant difference between the groups (p=0.001). SDR plus bulk fill in snow plow technique showed lower microleakage compared to Tetric N flow bulk fill in snow plow technique.

Table 1: Comparison of the microleakage between the groups using Mann-Whitney U test

Groups	N	Min	Max	Median	IQR	p value
Tetric N flow Bulk fill	24	.0497	.0933	0.05890	0.0129	0.001*
SDR plus	24	.0331	.0601	0.0398	0.0116	0.001*

4 | DISCUSSION

Polymerization shrinkage of resin composites is a drawback leading to microleakage that influences success and longevity of restorations. Various techniques and materials have been tried to minimize microleakage.

One such method is the use snow plow technique introduced by Opdam in which a less viscous material is applied as gingival increment, overlayed by packable composite resin and co cured.7 This improves the marginal adaptation of the material and subsequently reduces the microleakage. Also, the flowable layer acts as a stress absorber, thereby reducing the overall polymerization shrinkage stresses.8

An invitro study by Peutzfeldt et al, reported significantly lower microleakage with snowplow technique using flowable and packable composite resins.13 The literature shows limited studies in this technique with bulk fill composite resin.

Bulk fill composite resins were used in this study, as they exhibit increased depth of cure and reduced polymerization shrinkage.

Tetric N-Ceram is characterized by its excellent esthetic properties and easy handling as well as its clinical longevity. Tetric N-Ceram Bulk Fill and Tetric N-Flow Bulk Fill both contain "ivocerin" as the photoinitiator which is highly photoreactive and provides for increased depth of cure of upto 4mm.11 The new "Aessencio" technology is responsible for lowering the translucency of the material during the polymerization process which allows it to blend in seamlessly with the surrounding dental tissues. It also contains a patented "shrinkage stress reliever" with a low modulus of elasticity(10GPa) that effectively reduces the stress during polymerization.12

SDR plus is another bulk fill composite resin that was developed with a patented larger molecular weight UDMA resin (molecular weight of 849 g/mol for SDR resin compared to 513 g/mol for Bis-GMA).17 The SDR technology comprises the unique combination of such a large molecular structure with a chemical moiety called a "Polymerization Modulator" chemically embedded in the resin matrix. The high molecular weight and the conformational flexibility around the centered modulator enables it to dissipate more energy (and store less) during polymerization.18 It is designed to be overlayed with a methacrylate-based universal/posterior composite for replacing missing occlusal/facial enamel.

A study was done by Kaisarly et al, to evaluate the effect of flowable liners beneath a composite restoration applied via different methods on the pattern of shrinkage vectors.8 The results showed that flowable liners act as a stress reliever, and recommended to apply a thin or thick layer of flowable liner beneath bulk-fill composites.

A study was done by Tabatabaei et al, to compare the gingival microleakage of Class II composite restorations through three restorative methods, Conventional incremental, open sandwich and snow plow.7 The results showed that there is less microleakage in snow plow technique in which the intermediate material is used, compared to conventional incremental method.

A study by Sampaio et al, evaluated composite placed with the snowplow technique versus incremental placement, using the low stress flowable bulk-fill composite (SDR flow) as the first uncured flowable layer.14 They assessed marginal adaptation with SEM and micro-CT and found that the snowplow method produced fewer gaps than an oblique incremental technique, but similar to a horizontal increment method with conventional composite.

In the present study, SDR plus with Tetric N ceram bulk fill composite resin in snow plow technique (group I) showed lower microleakage with a median of 0.05890 (IQR 0.0129) compared to Tetric N flow and Tetric N ceram bulk fill composite resin in snow plow technique (group II) with a median of 0.0398 (IQR 0.0116). The results were statistically significant (P<0.05). This can be attributed to the higher molecular weight of UDMA resin and the polymerization modulator in the resin matrix of SDR which impart flexibility and dissipate energy during polymerization. This results in a minimal overall shrinkage (3.5%) when compared to other flowable composites.16 And the "Self-levelling" ability provides excellent cavity adaptation and hence good marginal sealing property.17 This SDR layer overlaid with Tetric N ceram bulk fill composite and cured in snow plow technique, would have improved its adaptation and sealing ability, resulting in reduced microleakage values.

In this study, human permanent mandibular molars were selected as Class II lesions are most commonly encountered in molars. Microleakage is frequently detected on the proximal gingival margins.19 In this study, class II box cavities were prepared and all the cavities had similar dimensions of 3mm buccolingually and 2mm mesiodistally to standardize the preparation.21 The gingival margins of the cavities were placed 1mm above CEJ.

After completing the restorations, the specimens were subjected to thermocycling. Thermocycling is an invitro process of subjecting the specimens to extremes of temperature to simulate oral conditions. In the oral cavity, restorations are subjected to both thermal and mechanical stress that also contributes to the increase of marginal leakage. Thermocycling is widely used method to determine if temperature variation might influence the bond strength and to simulate in vitro thermal changes that occur in the oral cavity.

To assess sealing efficiency of restorative material & microleakage, the most common method is the use of various dyes. In this study, 2% methylene blue dye was chosen for dye extraction because it is simple, economical and does not require any complex laboratory apparatus. Even particle size of this dye is less than internal diameter of dentinal tubules (1-4 μm) and can show dentin permeability.18 In dye extraction method, teeth are dissolved in acids that release all dye from the interface and optical density of solution is measured by adsorbing light via spectrophotometer. Dye extraction method presents a benefit over fluid filtration technique, as filtration values tend to diminish over time, as the water penetrates all irregularities until a plateau is reached.20 Hence, dye extraction method was used in our study to evaluate microleakage.

5.2 | CONCLUSION

Within the limitations of the present study, it can be concluded that,
• Both bulk fill composite resin class II restorations in the study exhibited microleakage at the tooth restoration interface.
• Snow plow technique of restoring class II cavities with SDR plus and Tetric N ceram bulk fill composite resin showed lower microleakage compared to Tetric N flow and Tetric N ceram bulk fill composite resin in snow plow technique.
Further studies in much deeper class II cavities with gingival margins 1mm below CEJ and different cavity configurations, along with long term clinical trials are needed.

CONFLICT OF INTEREST
The Authors declare no conflict of interest.

REFERENCES

1. Ferracane JL, Lawson NC. Probing the hierarchy of evidence to identify the best strategy for placing class II dental composite restorations using current materials. J Esthet Restor Dent. 2021;33(1):39-50.

2. El-Mowafy O, El-Badrawy W, Eltanty A, et al. Gingival micro leakage of Class II resin composite restorations with fiber inserts. Oper Dent. 2007;32(3):298–305.

3. Radhika M, Sajjan GS, Kumaraswamy BN, et al. Effect of different placement techniques on marginal microleakage of deep class-II cavities restored with two composite resin formulations. J Conserv Dent. 2010;13(1):9–15.

4. Lindberg A, van Dijken JW, Lindberg M. Nine-year evaluation of a polyacid modified resin composite/resin composite open sandwich technique in Class II cavities. J Dent. 2007 1;35(2):124-9.

5. Patel P, Shah M, Agrawal N, et al. Comparative evaluation of microleakage of Class II Cavities Restored with different bulk fill composite restorative systems: An in vitro Study. J Res Adv Dent. 2016;5(2):52-62.

6. Bavaria S, Shah N, Shah R, et al. A comparative evaluation of micro leakage of two different bulk fill composites with ever x posterior composite for class II restorations by dye extraction method-an in vitro study. IOSR – JDMS.2017;16(1):72-77.

7. Tabatabaei SH, Tamandi M, Naebi M. Evaluating Microleakage of class II Composite Resin Restorations through various restorative approaches-An Invitro study. J Appl Med Sci.2017; 5(6D):2330-2336.

8. Kaisarly D, Meierhofer D, El Gezawi M, et al. Effects of flowable liners on the shrinkage vectors of bulk-fill composites. Clin Oral Investig. 2021;25(8):4927-40.

9. Jin X, Bertrand S, Hammesfahr PD. New radically polymerizable resins with remarkably low curing stress. J Dent Res. 2009;88:1651

10. Ilie N, Hickel R. Investigations on a methacrylate-based flowable composite based on the SDR™ technology. Dent Mater. 2011;27:348–55.

11. Patel P, Shah M, Agrawal N, et al. Comparative evaluation of microleakage of Class II Cavities Restored with different bulk fill composite restorative systems: An in vitro Study. J Res Adv Dent. 2016;5(2):52-62

12. Moosavi H, Moghaddas MJ, Kordnoshahri F, et al. Microleakage Evaluation of Bulk-fill Composites Used with Different Adhesive Systems. J Dent Biomater. 2018 13;5(2):544-50.

13. Peutzfeldt A, Asmussen E. Composite restorations: influence of flowable and self-curing resin composite linings on microleakage in vitro. Oper Dent. 2002;27(6):569-75.

14. Sampaio CS, Garcés GA, Kolakarnprasert N, et. External marginal gap evaluation of different resin-filling techniques for class II restorations-a micro-CT and SEM analysis. Oper Dent. 2020;45(4):E167-e75.

15. Swift EJ, Triolo PT, Barkmeier WW, et al. Effect of low-viscosity resins on the performance of dental adhesives. Am J Dent. 1996;9:100–4.

16. Giovannetti A, Goracci C, Vichi A, et al. Post retentive ability of a new resin composite with low stress behaviour. J Dent. 2012;40:322–8.

17.Burgess J, Cakir D. Comparative properties of low-shrinkage composite resins. Compend Contin Educ Dent. 2010;31:10–5.

18. Rossouw RJ, Grobler SR, Theunis J, et al. A comparison of microleak ages of five different recent bonding agents/systems in enamel and dentine. SADJ. 2007;62(5):213–8.

19. García L, Climent A, Llena C. In vitro evaluation of microleakage in Class II composite restorations: High-viscosity bulk-fill vs conventional composites. Dent Mater J. 2019;38(5):721–7.

20. Derkson GD, Pashley DH, Derkson ME. Microleakage measurement of selected restorative materials: a new in vitro method. J Prosthet Dent. 1986;56(4):435-40.

21. Majety KK, Pujar M. In vitro evaluation of microleakage of class II packable composite resin restorations using flowable composite and resin modified glass ionomers as intermediate layers. J Conserv Dent. 2011;14(4):414-417.

Evaluation of the Antibacterial Activity of Various Concentrations of Raisin Extract against Streptococcus Mutants: An In-Vitro Study

Cyriac Philip[1] | Smitha B Kulkarni[1*] | Nagesh L[2] | Avinash J[3] | Nayana M[4] | Mahesh PC[5]

[1] General Practioner, Engapuzha, Kozhikode,Kerala, India

[1*] Former Reader, Department of Public Health Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India

[2] Former Professor Emeritus, Department of Public Health Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India

[3] Professor and Head of Department, Department of Public Health Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India

[4] Senior Lecturer, Department of Public Health Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India

[5] Former Senior Lecturer, Department of Public Health Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka, India

Correspondence
Corresponding author Nayana M
Email: nayanam@dscds.edu.in

Present address
Department of Public Health Dentistry,
Dayananda Sagar College of Dental Sciences,
Shavige Malleshwara Hills, Kumaraswamy Layout,
Bangalore 560 111; Karnataka; India.

Abstract

Background: Dental caries is one of the most common and costly diseases in the world. Although dental caries is rarely life threatening, it is a major problem for health service providers. S. mutans is considered as the pioneer organism in dental caries. Fruits like grapes and pomegranate have been found effective against S. mutans. Objectives: To find out minimum inhibitory concentration of black raisins extract against S. mutans and to assess whether the black raisins extract has antibacterial efficacy on S. mutans. Methods: In this in vitro study, compound isolatin of raisin extract was done using chloroform, hexane and methanol, prepared in Department of Pharmacology, Dayananda Sagar Institutions. Minimum inhibitory concentration of raisin extract was determined using optical density method. Evaluation of antibacterial activity was done using well diffusion method. Results: Minimum inhibitory concentration of raisin extract was observed at a concentra-tion of 125 μg/well at which an inhibition rate of 48.65% was observed. Minimum zone of inhibition of 16±0.0mm was observed at a concentration of 2.5 μg of raisins extract. Interpretation and conclusion: Raisins contain polyphenols, antioxidants, flavonoids and iron that may benefit overall human health. It has an MIC value of 125 μg/ml at which the rate of inhibition is 48.65%. The structural diversities and pronounced biological activities of compounds in raisins indicate that raisins are worthy of further studies that may lead to the identification of new functional constituents.

KEYWORDS
Raisin Extract, Streptococcus Mutants, Antibacterial Efficacy, Dental Caries

1 | INTRODUCTION

Dental caries is one of the most common non communicable and costly diseases in the world. Although dental caries is rarely life threatening, it is a major problem for health service providers.[1] According to Global Oral Health Data Bank, prevalence of dental caries varies from 49% to 83% across different countries.[2] An enhanced understanding of the role of the microorganisms in dental caries is needed to reduce the preva-lence of caries. S. mutans is considered as the pioneer organism in dental caries. S. mutans play a key role in the etiology of dental caries because it can adhere to the enamel salivary pellicle and to other plaque bacteria.[3] Addition of antiplaque or antibacterial agents to dental health care products has been of value in controlling dental caries.

Various products like cholorhexidine, sodium fluoride, xylitol and tri-closan have been found very effective in controlling S. mutans count.[4] Extracts containing polyphenols of plant origin gained more attention

of researchers for their use against drug-resistant pathogens.[5] Anti-bacterials or antibiotics from these sources have been found to be more efficient with fewer side effects and less cost of production.[6] Plant-based phenolic metabolites are beneficial to human health because of their potent antioxidation and wide range of pharmacologic properties such as antioxidant, anticancer, and platelet aggregation inhibition activities. It is important to stress more on natural products than artificial drugs. Going green has major benefits to patients and also environment.

Fruits like grape contain various nutrient elements, such as vitamins, minerals, carbohydrates, edible fibers and phytochemicals. Polyphenols are the most important phytochemicals in grape because they possess many biological activities and health promoting benefits. Polyphenolics from grapes and red wines attracted the attention of scientists to define their chemical composition and their properties for human health.

Black grape (Vitis vinifera) skin is a great source of phenolic compounds, which contains simple compounds (monomers) to complex tannin type substances (oligomers and polymers). The various classes of negatively charged polyphenols that have been identified in grapes, such as phenolic acids (benzoic, hydroxycinnamic acids), stil-bene derivatives (resveratrol), flavanols (catechin,epicatechin), flavonols (kaempferol, myricetin), anthocyanin and many more.

These polyphenols boast many beneficial effects on human health such as inhibition of free radical damage, antibacterial, antifungal, increase cardiovascular health, anticarcinogenic and anti-inflammatory actions on human health.[7] Grape as a whole is generally underutilized and thrown away by the wine factory as waste products. Grape skins are rich sources of anthocyanins, hydroxycinnamic acids, flavanols and flavonol glycosides in which flavanols are mainly present in the seeds.[8]

Anthocyanins give black grapes their color. It is present in a huge amount as compared to other polyphenolic compounds. The higher amounts of dimers and trimers of epicatechin which possess a higher antibacterial activity than monomer ones.[9] Thus black grape is found to have both antifungal and antibacterial activities.[10]

Catechins, along with other polyphenols are highly negatively charged phytochemicals, that give the antifungal property to black grape. The phenolic compounds from different parts of grape have shown different antibacterial effects. antibacterial activity of fermented grape was either as effective as or significantly better than whole fruit grape extracts.[11] Various compounds in grape are being studied for their activity against S. mutans.

There is scarce literature reporting the antibacterial activity of raisins extract against S. mutans. The purpose of this study was to assess antibacterial activity of chloroform soluble black grape raisins extract against S. mutans.

2 | METHODOLOGY

Study Design: In vitro study

Study Setting: The raisin extract was prepared in Department of pharmacology, Dayananda Sagar Institutions. The calculation minimum inhibitory concentration of raisin extract was done at In vivo Bioscience lab, Magadi road, Bangalore.

Materials used:

Black Grape (Vitis V iniferous Ethanol 99% v/v)

Hexane (80% v/v)

S. mutans (25175) Ciprofloxacin (0.1 mg/mL)

Distilled Water

Soya bean Casein Digested agar plates

Compound isolation:

The dried and ground raisins (500 mg were extracted with one litre of ethanol three times by maceration, for up to three days. The resultant extracts were combined and concentrated in vacuo at 40 degree celsius. The concentrated extract was suspended in 90% ethanol (250 ml), and then partitioned with 250 ml of hexane three times to afford hexane soluble syrup on drying. Next, the aqueous methanol extract was partitioned with 250 ml of chloroform three times to give a chloroform soluble extract as per study by Zhu et al. [12]

Estimation of minimum inhibitory concentration:[13]

It was done by mixing 90μl test compounds of different test concentration with 10μl Inoculum and was kept in 96 well plates. For Control, 90μl peptone broth without drug was used. The S.mutans treated plate was incubated at 370C for 24 to 48 hours and optical density at 590 nm was measured using a tecan plate reader. Minimum inhibitory concentration of grape extract giving 50After incubation 20μl Resazurin (1000μg/ml was added to each well and incubated for 4hr to confirm the viability of culture.

Evaluation of ANTIBACTERIAL activity by Well Diffusion Method:

The antibacterial activity was determined by well diffusion technique. It was performed on soya bean casein digested agar plates. S. mutans (ATCC 25175) was used as test organism and Ciprofloxacin (100 μg/mL) was used as standard.[14] Distilled water was used as a control. S. mutans (100μl) was inoculated on soya bean casein digested agar plates (90 mm). Raisins extract (25 μl), standard ciprofloxacin (25μl) and Control (25μl) for S. mutans were added to the 5mm well on agar plates. The treated plates with S.mutans were incubated at 370C for 24-48 hrs. The Minimum inhibitory concentration of raisin extract was determined by the ability of each substance to inhibit the growth of S. mutans around the 90 mm wells in soya bean casein digested agar plates. (Fig: 1)
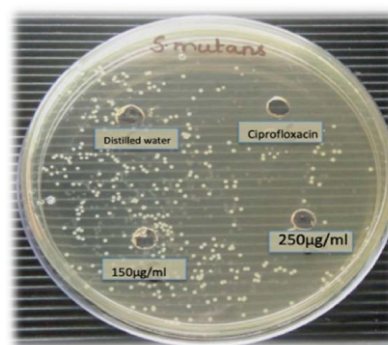

Fig: 1 Soya Bean Case in Digested Agar Plate showing Zone of Inhibition

3 | RESULTS

Various concentrations of raisins were used to find the minimum inhibitory concentration of the extract. At 15.62 µg/well concentration, 15.19% inhibition was found for raisins extract. The concentration of raisins extract was gradually increased up to a concentration of 1000 µg/well at which the inhibition of 75.98 % was observed. Minimum inhibitory concentration of raisin extract was observed at a concentration of 125 µg/well at which an inhibition rate of 48.65 % was observed.

For ciprofloxacin, 50% inhibition or an MIC value was observed at a concentration of 0.5 µg/well.

Minimum zone of inhibition of 16±0.0 mm was observed at a concentration of 2.5 µg of raisins extract. There was no zone of inhibition found at a concentration of 1.5 µg of raisins extract. Minimum zone of inhibition of 25±0.0 mm was observed at a concentration of 2.5µg for ciprofloxacin.

4 | DISCUSSION

The presence of anthocyanins, in a huge amount as compared to other polyphenolic compounds gives black grapes their colour. The amount of total polyphenols in the black grape varieties is higher as compared to that of green grape, due to the presence of the anthocyanins. The antibacterial property is also aided by the presence of polyphenols like oleanolic aldehyde, linoleic acid, linolenic acid, botulin, betulinic acid, 5-(hydroxymethyl)-2-furfural, rutin, b-sitosterol, and b- sitosterol glucoside were identified by comparing their physical and spectroscopic values. as an antibacterial agent, these polyphenols can penetrate the semi permeable cell membrane where they react with the cellular proteins. The intention of the current study was to check whether higher concentration gives better efficacy against S mutans. This study also evaluated the MIC of raisins extract collectively against S. mutans.

A study conducted by Cruz. J.F and Zhu. M [12] using the same method as the present study assessed the MIC of various compounds in raisins extract individually. The results of the study showed that various polyphenols in raisins showed different MIC values against S. mutans. The MIC values for different polyphenols were Oleanolic acid (625 µg/ml), Lineoleic acid (488 µg/ml), Rutin (250 µg/ml) and for 5 Hydroxymethyl-2- furfural (31 µg/ml). The results of the current study could not be compared with this study because current study compared the MIC value of raisins extract collectively.

A study was conducted by Yadav D, Kumar A and Mishra D [13] to find the antibacterial activity of black grape. The results of thier study showed that the extracts showed MIC of 260 µg /ml polyphenols against S. aureus and E. aerogenes. MIC of 540 µg/ml was found against E.faecalis. In this study the MIC value against S. mutans was not determined. Thus results of the current study could not be compared with this study.

In the present study we found an MIC value of 125 µg/ml against S.mutans. The zone of inhibition was determined by well diffusion technique using soya bean casein digested agar plates and it was found to be 16 mm after incubating it for 48 hours at 37°C. The results of the current study could not be compared with that of other studies as this is the first study of its kind which compared the MIC value of raisins extract collectively.

Limitations of the study:

Firstly, it was an in vitro study; the results cannot be extrapolated to in vivo situation. Secondly, in this study the MIC value for polyphenol components was determined collectively and further studies determining the MIC of individual polyphenol compound in the black raisin extract need to be conducted.

Further studies are recommended using Innovative technologies to obtain the pure black raisins extract and in vivo studies has to be conducted to find the efficacy of black raisins extract. Assessing the antibacterial efficacy against S. mutans is a surrogate end point but the true end point is the change in dental caries that has to be detected or find out using longitudinal studies.

Table1: Inhibitory activity of test compounds against test organism

Test Organisms	Test Compounds	Concentration per well	Zone of inhibition (mm)
Streptococcus mutans	Control	-	-
	Ciprofloxacin (Standard)	2.5µg	25±0.0
	Streptococcus mutans	2.5mg	16±0.0
		1.5mg	-

Table 2: Determination of Minimum Inhibitory concentration of Standard (Ciprofloxacin) against S.mutans.

Standard Conc. (µg/well)	S.mutans OD	% Inhibition
0	0.62	0
0.125	0.51	17.42
0.25	0.45	26.94
0.5	0.31	50
1	0.24	60.81
2	0.18	71.13
4	0.14	77.14
8	0.09	85.48
MIC(µg/well)	0.5 µg	

Table 3: Determination of Minimum Inhibitory concentration of raisin extract against S.mutans

Sample Conc. (µg/well)	S.mutans OD	% Inhibition
0	0.60	0.00
15.62	0.51	15.19
31.25	0.43	28.61
62.5	0.38	37.39
125	0.31	48.65
250	0.26	57.10
500	0.20	67.37
1000	0.15	75.98
MIC (µg/well)	250µg	

5 | CONCLUSION

Raisins have been consumed for a long time and are commonly used in various food preparations. The studies have demonstrated an inverse association between intake of raisins and mortality from age related diseases such as coronary heart diseases. Anthocyanins, flavonoids and resveratrol are the major functional components that are responsible for most of biological activities of grape. The health benefits of grape are thought to arise mainly from bioactivities of their polyphenols.

Raisins contain polyphenols, antioxidants, flavonoids and iron that may benefit overall human health. Black raisins are found to have antibacterial efficacy against S.mutans and also has several other health benefits. It has an MIC value of 125 μg/ml at which the rate of inhibition is 48.65%. Raisins are worthy of further studies that may lead to the identification of new functional constituents due to their distinctive structure and marked biological activities of the compounds present in them.

Structural diversities and pronounced biological activities of compounds in raisins indicate that going green has a major benefit to the patients and also to environment thus the usage of raisins should be promoted in daily usage.

6 | ACKNOWLEDGEMENTS

CONFLICT OF INTEREST

The Authors declare no Conflict of interest.

REFERENCES

1. S Forssten, MBjorklund, A Ouwehand . Streptococcus mutans, Caries and Simulation Models. Nutrients 2010, 2, 290-298.

2. WHO. World health data base.2015.

3. Lamont, R.J.; Demuth, D.R.; Davis, C.A.; Malamud, D.; Rosan, B. Salivary- Agglutinin-Mediated Adherence of Streptococcus-Mutans to Early Plaque Bacteria. Infect. Immun. 1991, 59, 3446-3450.

4. P Shah, D Shirol. Comparison of ANTIBACTERIAL efficacy of chlorhexidine and combination mouth rinse in reducing the Mutans streptococcus count in plaque. Journal of Indian Society of Pedodontics and Preventive Dentistry 32(2):91-6

5. Siva R, Palackan MG, Maimoon L, Geetha T, Bhakta D, Balamurugan P, et al. Evaluation of antibacterial, antifungal and antioxidant properties of some food dyes. Food Sci Biotechnol 2011;20:7-13.

6. Papadopoulou, C.; Soulti, K.; Roussis, I.G. Potential ANTIBACTERIAL activity of red and white wine phenolic extracts against strains of Taphylococcus aureus, Escherichia coli and Candida albicans. Food Technol. Biotechnol. 2005, 43, 41−46.

7. Oliveira DA, Salvador AA, Smânia A Jr, Smânia EF, Maraschin M, Ferreira SR. ANTIBACTERIAL activity and composition profile of grape (Vitis vinifera) pomace extracts obtained by supercritical fluids. J Biotechnol 2013; 164:423- 32.

8. Nurmahani MM, Osman A, Hamid AA, Ghazali FM, Dek MS. Antibacterial property of Hylocereus polyrhizus and Hylocereus undatus peel extracts. Int Food Res J 2012;19:77-84.

9. Droby S, Wisniewski ME, Cohen L, Weiss B, Toutou D, Eilam Y, et al. Influence of CaCl2 on Penicillium digitatum, grape fruit peel tissue and biocontrol activity of Pichia guilliermondii. Biol Control 1997; 87:310-315.

10. J.R. Just, M.A. Daeschel, ANTIBACTERIAL effects of wine on Escherichia coli O157:H7 and Salmonella typhimurium in a model stomach system, J. Food Sci. 68 (2003)285−290.

11. Papadopoulou, C.; Soulti, K.; Roussis, I.G. Potential ANTIBACTERIAL activity of red and white wine phenolic extracts against strains of Taphylococcus aureus, Escherichia coli and Candida albicans. Food Technol. Biotechnol. 2005, 43, 41−46.

12. Rivero-Cruz JF, Zhu M, Kinghorn AD, Wu CD. ANTIBACTERIAL constituents of Thompson seedless raisins (Vitis vinifera) against selected oral pathogens. Phytochemistry letters. 2008 Nov 3;1(3):151-4.

13. Yadav D, Kumar A. antibacterial properties of black grape (Vitis vinifera L.) peel extracts against antibiotic-resistant pathogenic bacteria and toxin producing molds. Indian Journal of Pharmacology.2015. 47.6. 663-667.

14. Greenblatt DJ. Analysis of drug interactions involving fruit beverages and organic anion-transporting polypeptides. The Journal of Clinical Pharmacology. 2009 Dec;49(12):1403-7.

To Evaluate Knowledge Awareness and Outlook Regarding Teledentistry Among Dentists in Bangalore- A Cross-Sectional Study

Kavitha. M[1]| Tasneem. S.M[2]| R. Venkatasubramanian[3]

[1]Reader, Department of Pediatrics and Preventive Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru.

[2]Private practitioner, Ballari, Karnataka.

[3]Professor and Head, Department of Pediatric and Preventive Dentistry, Dayananda Sagar College of Dental Sciences, Bengaluru.

Corresponding author: Dr. Kavitha M
Email: kavitham@dscds.edu.in

Address
Department of Pediatrics & Preventive Dentistry
Dayananda Sagar College of Dental Sciences
Dayananda Sagar Institutions
Shavige Malleshwara Hills, Kumaraswamy
Layout, Bangalore 560 111; Karnataka; India.

Abstract

A rapidly developing country like India still has to face the problems of lack of availability of access to medical and dental care even today. With rapid digitalization happening all across the globe, the idea of using it to clear the gap between the patient and the dentist is a new revolution in the field of telemedicine. This article evaluates the awareness and outlook of dentists in south Bangalore concerning teledentistry. It also includes a discussion based on different questions and how dentists from different specialties and age groups answered them. We can conclude with this article, that, teledentistry is a very viable option for oral health care for those who have difficulty accessing it and that dentists are very open to accepting and adopting it.

KEYWORDS

Teledentistry, Telemedicine, Teleconsultation, Pandemic, Awareness, Outlook.

1 | INTRODUCTION

Oral healthcare is a basic amenity that must be accessible to all. Unfortunately, in today's world, access to healthcare for all is still a challenge due to the lack of availability of doctors and facilities in certain regions of the country due to various factors. In emergent countries, the inhabitants of rural establishments find it difficult to access an oral health care specialist, as they are mostly found in urban cities.[1] One way of overcoming this challenge is by the implementation of teledentistry. Through teledentistry, it is possible to reach patients who do not have access to a dentist or cannot make the visit to the dentist due to barriers such as lack of time, morbidities, disabilities, security concerns, poverty, etc.

Healthcare has been rapidly digitalized in the last few years with the advancement of technology in medicine. This development has become even more pronounced because of the pandemic that hit the entire world with fear and panic of visiting their healthcare providers for regular care, for the fear of contracting the virus. Telemedicine, which had been in use even before the pandemic, became even more popular during the pandemic-induced stringent lockdowns.

Telemedicine is derived from "tele" in Greek, meaning distance, and "menderi" in Latin, meaning to heal.[2] Teledentistry involves the use of communication technology for providing dental care, consultation, and awareness in urban as well as rural areas. Using teledentistry, it is easier to identify high-risk populations, arrange for a referral to a dental surgeon or specialist, and encourage locally-based treatment. These save time, productivity as well as travel expenditure for the patient as well as the doctor.[3] Teledentistry can be used in all the specialties of dentistry.[4] Teledentistry has many advantages such as being cheaper than traditional in-person consultations, reduced travel expenses and time, and easier to take multiple opinions from other specialties. There is substantial evidence that proves higher patient satisfaction with e-oral health care. Patients had shown willingness for teleconsultation for a dental problem, and they were on the whole content due to saved travel time, saved working days, and swift treatment onset.[5] A few studies conducted showed that the use of teledentistry reduced the time spent by patients in the ED for non-traumatic dental conditions and also allowed the ED doctor to be able to attend to other emergent patients more effectively. The mean waiting time for patient-provider interaction was 40 minutes, mean time spent by dental patients inside the ED room was 46 minutes.[6]

Abbreviations: ED, Emergency Department

Studies conducted on connecting medical personnel to the dentist via teledentistry have shown good responses with only a few technical errors due to a lack of training on how to use the technology provided.[7] Studies have also been conducted on the awareness and acceptability of teledentistry among patients, with results showing that many were accepting of teledentistry. This study in particular questions the dentists in the city of South Bangalore on their knowledge and acceptability of teledentistry.

This study aims to instill the knowledge, awareness, and implementation of teledentistry among the general practitioners and dentists in Bangalore it is important to assess the awareness and outlook toward teledentistry among them. Hence the study is conducted among general practitioners to know their knowledge, awareness, and outlook toward teledentistry.

2 | MATERIAL AND METHODOLOGY

STUDY DESIGN AND STUDY POPULATION

The study is a cross-sectional study involving an electronic survey for general practitioner dentists, validated 18 close-ended, self-made questionnaires were incorporated to evaluate the knowledge, outlook, and awareness among the general practitioner dentists residing in south Bangalore. The survey was mailed to a random sample of 120 general practitioner dentists from all 9 specialties with professional experience from 0 to 25+ years. South Bangalore was chosen for this survey due to it being a metropolitan city with good access to the internet as well as dental care.

INCLUSION CRITERIA

All the general practitioners who gave their consent to participate in the study were considered in the inclusion criteria.

DATA COLLECTION AND ANALYSIS

This was a cross-sectional survey-based study, where a validated 18-item questionnaire was distributed via online Google Forms. The survey form comprised 3 parts which included as follows-

1. Part 1: Sociodemographic details

2. Part 2: Questions related to knowledge regarding teledentistry

3. Part 3: Questions relating to assessing the awareness and outlook regarding teledentistry.

The completed questionnaire was collected and subjected to statistical analysis in terms of frequencies (yes or no) with a statistical package for social science (SPSS).

Furthermore, the sample was stratified by qualification and gender to get more representative samples of general practitioner dentists.

3 | RESULTS

A total of 250 general practitioner dentists from all 9 specialties with professional experience from 0 to 25+ years were covered in the study but only 200 participants responded and gave consent to participate in the study. Thus the response rate was 80%.

The majority of general practitioners (90%) had an understanding of teledentistry. 90% of general practitioner dentists think teledentistry helps to seek advice from an expert about a specified patient's problem.

86.7% knew that teledentistry is used for oral health education and continuing education in dentistry.

85% of general practitioner dentists feel teledentistry is a good option rather than in-person examination during a pandemic.

81.7% of general practitioner dentists think teledentistry is useful; in early diagnosis and easy consultation on oral diseases.

When dentists were asked whether teledentistry comprises the practice of using computers, the internet, and technologies for diagnosis and to give their opinion on a patient's treatment, a high response of 88.3% was obtained. 93.3% of participants agreed that teledentistry lessens chair side time, money, and travel for the dentist and the patient.

The majority of study participants concurred that teledentistry is a good option for the dentist as it reduces personal contact and lessens the risk of contamination during a pandemic.

85 % of participants think that teledentistry can expand the ease of access to specialists in rural and underserved communities for the dental communities for dental needs.

High responses (88.1%) were observed for the question: "Can teledentistry be an addition to regular dental care?".

Regarding the question of whether teledentistry is useful in quick diagnosis and effortless consultation, the response was 81.7%.

Similarly, 67.8% of respondents agreed with the question: "Do you think that teledentistry can be used to train dentists in primary dental care?".

Only a few respondents (45%) believed that teledentistry can violate patients' privacy.

66.1% of participants have had a consultation with a patient using a smartphone and its camera.

When enquired about attending a lecture or course about teledentistry, only 30% of participants responded with 'yes'.

Similarly, only 21% of participants have experience in using teledentistry.

65% of respondents think that teledentistry will be a standard method of oral health care delivery in the future.

66.7% of general practitioner dentists have communicated with the patient during the (pandemic) situation.

A high response of 91.7% was obtained for the question: "Will you practice teledentistry in the future?".
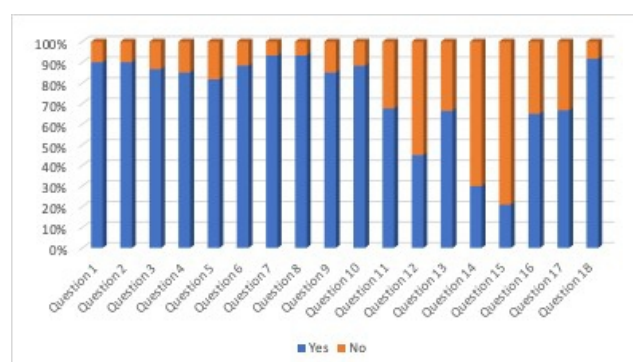
Fig 1: Bar diagram representing the responses to all the questions.

Teledentistry is not a new specialty. It is, in actuality, a different method for providing dental services. The advantage of teledentistry in remote areas cannot be stressed enough. Its application is of greatest significance in rural and urban areas where there is a dearth of specialist consultation. Teledentistry has been advancing since 1994 as a means to allow dental professionals to communicate with one long distance, allow collaboration by multiple practitioners, and involve the exchange of clinical information and images over remote distances for dental consultations and treatment planning.[8]

In the present study, the knowledge and awareness regarding teledentistry were assessed among general practitioner dentists. The majority of practitioners were aware of teledentistry but very few had attended a lecture or hands-on training in using teledentistry.

The majority of participants (86.7%) were aware that teledentistry can be used for dental health education. 93.3% of participants believed that teledentistry lessens chair time, money, and travel for the dentist and the patient. Similar results were seen in a study conducted by Bauer et al. (2001).[9]

The questions regarding the use of teledentistry to seek advice from an expert about the patient's ailment had been agreed upon by 90% of participants. Similar results have been obtained in other studies regarding the same.[10,11]

Noteworthy contrast was found in response to questions like, "Do you think that teledentistry can be used to train dentists in primary dental care?" (67.8%).

In a study aimed at discerning the willingness of patients to undergo online consultation, it was found that a major portion (87%) were inclined towards recommending the use of digital, remote counseling instead of face-to-face appointments with their family and friends, while only 13% were apprehensive of recommending it.[12]

In the present study, it was found that 90% of general practitioner dentists knew teledentistry.

Very few (45%) participants think teledentistry can violate patients' privacy, dentists who are engaged in teledentistry must ensure the safety and security of their systems and transmitted data. User access logs, password protection, and data encryption can help in protecting patient confidentiality.

A study conducted in Saudi Arabia showed that one-third of participants think that teledentistry might breach patient privacy, and it was ranked by participants as one of the most significant hurdles to teledentistry use.[13]

Other studies conducted showed that dentists with 11 to 15 years of experience showed the lowest score for excitement as they were resistant to the new technology not to lose their patient pool.[14]

In other studies conducted it was found that only 74% of dental practitioners feel that dental examinations via computers and intraoral cameras are as precise as dental clinic exams.[15]

The study is limited in the aspect that it included only dentists practicing in south Bangalore who live in a metropolitan city and have good access to the internet and also that they cannot be used to extrapolate the results to other populations. The study also did not include dental students who are going to be the most influenced by changes such as teledentistry entering clinical dentistry.

Table 1: Sociodemographic characteristics

Age (Years)	Frequency (in %)
20-30	73.8
30-40	23
40-50	3.2
Sex	
Males	65.6
Females	34.4

The above table gives the sociodemographic details of the participants of the study. With the help of this data, it was made possible to understand the differences in the adaptability of practitioners with different years of work experience. (Table 1)

The above table gives the sociodemographic details of the participants of the study. With the help of this data, it was made possible to understand the differences in the adaptability of practitioners with different years of work experience. (Table 1)

Table 2: Dentists from various specialists who participated in the study

Field of Specialty	Frequency (in %)
General Practitioner	37.70
Oral and Maxillofacial Surgery	8.30
Endodontics	14.8
Oral Diagnosis/ Radiology	4.66
Orthodontics	2.33
Pediatric Dentistry	16.00
Periodontology	2.33
Restorative Dentistry	4.66
Prosthodontics	9.32

The above table gives the distribution of the participants who participated in the study based on their specialty. This data gives insight into what practitioners of different specialties feel they can achieve through teledentistry and are more open to adapting it. For example, in a study conducted. It was seen that the majority of participants selected community dentistry followed by oral medicine, dental hygiene, and orthodontics to be benefited from teledentistry. (Table-2) This reflects a narrower vision of limiting teledentistry to screening, diagnosis, or patient education.[16]

Table 3: Response to Knowledge, Awareness and Outlook-Related Questions

Q. No	Knowledge, awareness, and outlook-related questions	Yes (%)	No (%)
1.	Do you know what teledentistry is?	90	10
2.	Do you think teledentistry helps to consult with an expert about a specific patient's problem?	90	10
3.	Do you know that teledentistry is used for dental health education and continuing in dentistry?	86.7	13.33
4.	Do you think teledentistry is a good option rather than an in-person examination during the pandemic?	85	15
5.	Do you think teledentistry is useful in early diagnosis and easy consultation on oral diseases?	81.7	18.33
6.	Is teledentistry about the practice of the use of computers, the internet, and technologies to diagnose and provide advice about treatment over a distance?	88.33	11.66
7.	Do you think that teledentistry lessens chair side time, money, and travel for a dentist and the patients?	93.33	6.66
8.	Do you agree that teledentistry is a good option for the dentist as it reduces personal contact and lessens the risk of contamination during the pandemic?	85	15
9.	Do you think that teledentistry can increase the accessibility to specialists in rural and underserved communities for their dental needs?	85	15
10.	Can teledentistry be an addition to regular dental care?	88.1	11.66
11.	Do you think that teledentistry can be used to train dentists in primary dental care?	67.8	32.5
12.	Do you think that teledentistry can violate patients' privacy?	45	55

Sl. No	Knowledge, awareness, and outlook-related questions	Yes (%)	No (%)
13.	Have you ever had a consultation with a patient using a smartphone and its camera?	66.1	33.33
14.	Have you attended a lecture or course about teledentistry?	30	70
15.	Did you think that in the future, teledentistry will be a standard method of oral health care delivery?	21	79.1
16.	Did you have hands-on training in using teledentistry?	65	35
17.	Have you communicated with any patients during the pandemic situation?	66.7	33.33
18.	Will you practice teledentistry in the future?	91.7	8.33

4 | CONCLUSION

The results of the study indicated satisfactory knowledge, awareness, and outlook regarding teledentistry among general dentists. The knowledge and awareness can be improved further by the continuation of dental education programs and awareness campaigns. Concerns such as adaptability to new technology and security risks need to be addressed. With all the technological developments taking place in the field of teledentistry, practitioners may eventually link up to virtual health clinics and an entirely new era of dentistry can be created.[16]

5 | ACKNOWLEDGMENT

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

1. Tella AJ, Olanloye OM, Ibiyemi O. Potential of Teledentistry in the Delivery of Oral Health Services in Developing Countries. Ann Ib Postgrad Med. 2019:115-123.

2. Mihailovic B, Miladinovic M, Vujicic B. Telemedicine in dentistry (Teledentistry) Applications in Various Medical Disciplines and Geographical Areas. Rijeka (Croatia): InTech; 2011. P. 215-30.

3. Raja KP, Pal A, Nayak SU, Pai K, Shenoy R. Teledentistry: A new oral care delivery tool among Indian dental professionals - A Questionnaire study. 2022 ;11:666.

4. Jain A, Bhaskar DJ, Gupta D et al. Teledentistry: Upcoming trend in dentistry. J Adv Med Deni Sci 2013;1:112-5.

5. Emami E, Harnagea H, Shrivastava R et al. Patient satisfaction with e-oral health care in rural and remote settings: a systematic review. Syst Rev. 2022 ;11(1):234.

6. Abdelrahim A, Shimpi N, Hegde H et al, A Feasibility of establishing a tele-dental approach to non-traumatic dental emergencies in medical settings. Am J Dent. 2020b;33(1):48-52. PMID: 32056416; PMCID: PMC7354845.

7. Hammersmith KJ, Thiel MC, Messina MJ, Casamassimo PS, Townsend JA. Connecting Medical Personnel to Dentists via Teledentistry in a Children's Hospital System: A Pilot Study. Front Oral Health. 2021 Dec 9;2:769988.

8. Boringi M, Waghay S, Lavanya R, Babu DB, Badam RK, Harsha N et al. Knowledge and awareness of teledentistry among dental professionals- A cross sectional study. J Clin Diagn Res 2015; 9: ZC41-4.

9. Ata SO, Ozkan S. Information Technology in Oral Health Care : attitudes of Dental Professionals on the Use of Teledentistry in Turkey, European and Mediterranean Conference on Information Systems.

10. Daniel SJ, Wu L, Kumar S. Teledentistry : A systematic review of clinical outcomes, utilization and costs, J Dent Hyg 2013;87:345-52.

11. Torres-Pereira C, Possebon RS, Simoes A, Bortoluzzi MC, Leao JC, Giovanini AF, et al. Email for distance diagnosis of oral diseases; A preliminary study of teledentistry. J Telemed Telecare 2008; 14:435-8.

12. Watfa MO, Bernfeld NM, Oren D, Shani T, Zigron A, Sela E, Granot Y, Dror AA, Srouji S. Rapid implementation of teledentistry during the COVID-19 lockdown. Advances in Oral and Maxillofacial Surgery. 2021 April-June;2:100031.

13. Ata SO, Ozkan S. Information technology in oral health care: Attitudes of dental professionals on the use of teledentistry in Turkey. Proc Eur Mediterr Conf Inf Syst. 2009:1–8.

14. Al-Khalifa KS, AlSheikh R. Teledentistry awareness among dental professionals in Saudi Arabia. PLoS One. 2020 ;15(10).

15. Aboalshamat KT. Awareness of, Beliefs about, Practices of, and Barriers to Teledentistry among Dental Students and the Implications for Saudi Arabia Vision 2030 and Coronavirus Pandemic. J Int Soc Prev Community Dent. 2020 6;10(4):431-437.

16. Jampani ND, Nutalapati R, Dontula BS.Applications of teledentistry: A literature review and update. J Int Soc Prev Community Dent. 2011 37-44. doi: 10.4103/2231-0762.97695. PMID: 24478952; PMCID: PMC3894070.

Attrition As A Risk Factor In Interdental Papillary Health – A Prospective Observational Study

Savita AM[1] | Jisha S Raj[2]

[1]Professor and Head of Department, Associate Dean-PG Studies, Department of Periodontology, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[2]Post Graduate Student, Department of Periodontology, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

Correspondence
Corresponding author Savita AM
Email: savitaam@dscds.edu.in

Present address
Department of Periodontology, Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 111; Karnataka; India.

Abstract

Background: The interdental papilla that occupies the gingival embrasure plays a crucial role in maintaining the gingival health as it acts as a biological barrier and protects the underlying periodontal structures from microbial invasion and also has an important role in phonetics and aesthetics. The health of interdental papilla is influenced by various factors and dental attrition which is seen to have a high prevalence rate also influences the papillary health. Objective: To assess the relation and correlation between attrition and interdental papillary health. Methods: A prospective observational study was conducted and data was collected from 55 samples. The participants were assessed clinically for Plaque Index, Sulcus Bleeding Index, Papilla Presence Index and Hooper et al.'s classification for tooth wear. The data was then subjected to statistical analysis and results were obtained. Results: The Plaque Index (P = 0.0041), Sulcus Bleeding Index (P < 0.0001) and Papillary Presence Index (P < 0.0001) was found to be positively correlated with the tooth wear index. Conclusion: As observed from this study, a positive correlation was found between tooth wear, Plaque Index, Sulcus Bleeding Index and Papilla Presence Index, hence is suggestive of a risk factor for periodontal health.

KEYWORDS
Attrition, Interdental papilla, Plaque index, Sulcus bleeding index, Papilla presence index

1 | INTRODUCTION

The interdental papilla occupies the gingival embrasure, which is the interproximal space apical to the area of tooth contact.[1] The shape of interdental papilla can be pyramidal in the anterior or "col" shaped in the posterior.[2] It acts as a biological barrier and protects the underlying periodontal structures from microbial invasion while playing a crucial role in phonetics and aesthetics.[3] An array of problems arises ranging from phonetics to food impaction and aesthetic disharmony in case of papillary pathology.[4] Hence integrity and preservation of the interdental papilla is an essential part of the functional and aesthetic rehabilitation of dental treatment. The health of interdental papilla is influenced by age, gender, brushing techniques, oral hygiene and clinical crown height.[5, 6] Attrition is the loss of tooth structure due to mechanical grinding or interaction with other teeth. It is caused by tooth-to-tooth contact, usually where the teeth meet on the incisal or occlusal edges. Well-defined, sharp, flat and shiny wear marks, known as 'facets' appear on molar and premolar tooth cusps or ridges. Attrition on anterior teeth results in matching wear patterns between maxillary and mandibular teeth.

Tooth grinding (bruxism) is a main cause of this type of tooth wear.[7] Dental attrition is seen to have a prevalence rate of 29% in the South Indian population[8] and might lead to plaque accumulation and also aggravate the periodontal disease already present. Hence an attempt was made to evaluate the effect of attrition on interdental papillary health.

2 | MATERIALS AND METHODS

SOURCE OF DATA
Study was conducted on out patients reporting to the Department of Periodontology, Dayananda Sagar College of Dental Sciences, Bengaluru. Male: Female ratio – 1:2

STUDY DESIGN Experimental method – Prospective observational study

SAMPLE SIZE DETERMINATION Sample size estimation was done using R-Software 3.4.2 with effect size at 0.2, α error – 0.05 and power – 0.95. The output generated suggested a total sample size of 55.

PARTICIPANTS

Inclusion criteria
- Patients with attrition of either anterior or posterior teeth.
- Patients in the age group of 25-60 years.
- Patients with a minimum of a total of 24 natural teeth.

Pearson's Correlation Coefficient	Tooth wear index vs Plaque index	Tooth wear index vs Bleeding index	Tooth wear index vs Papilla presence index
r	0.314	0.6549	0.6696
95% confidence interval	0.1041 to 0.4971	0.5104 to 0.7634	0.5295 to 0.7741
R squared	0.09859	0.4288	0.4484
P (two-tailed)	0.0041	<0.0001	<0.0001
P value summary	**	****	****
Significant (alpha = 0.05)	Yes	Yes	Yes
Number of XY Pairs	82	82	82

Table 1. Correlation between Tooth wear index and Plaque Index, Bleeding Index and Papilla presence index using Pearson's Correlation Coefficient

Exclusion criteria
• Patients diagnosed with Stage I, Stage II, Stage III and Stage IV periodontitis.
• Patients suffering from any form of systemic diseases.
• Patients currently on antibiotic/anti-inflammatory therapy, steroids or hormonal therapy within the past 6 months.
• Patients with history of any dental therapy in the past 14 days.
• Patients with oral abusive habits such as smoking, consumption of alcohol or tobacco.
• Patients diagnosed with any form of psychosomatic disorders.
• Patients with parafunctional habit of bruxism.

CLINICAL PARAMETERS
The study data were entered into a standard proforma.
All the participants were assessed clinically for Plaque Index [Sillness J and Loe H, 1967][9], Sulcus Bleeding Index [Muhlemann HR, 1971] [10], Papilla Presence Index [Cardaropoli, 2004][11] and Hooper et al.'s classification for tooth wear [2004] [12]

STATISTICAL ANALYSIS
The data collected from each subject were entered into Excel sheet and a master chart was prepared. The data was analysed using R-Software 3.4.2. The data was tested for normality and Pearson's correlation coefficient was computed between tooth wear index, Plaque Index, Sulcus Bleeding Index and Papilla Presence Index. The result was considered statistically significant whenever P<0.05.

3 | RESULTS

A. Correlation between Tooth wear index and Plaque Index
The Pearson's Correlation of Tooth wear v/s Plaque Index was found to be positively correlated (r = 0.314), P = 0.0041 with 95% confidence interval (0.1041, 0.4971) which was seen to be statistically significant. Although there was a positive relation between Tooth wear index and Plaque Index, the contribution to the relation between Tooth wear index and Plaque Index was only 9.86%.
B. Correlation between Tooth wear index and Sulcus Bleeding Index
The Pearson's Correlation of Tooth wear v/s Sulcus Bleeding Index was found to be positively correlated (r = 0.6549), P < 0.0001 with 95% confidence interval (0.5104, 0.7634) which was seen to be statistically highly significant. Further the R-squared was 0.4288, i.e., change in tooth wear index contributed by Bleeding Index was 42.88%.
C. Correlation between Tooth wear index and Papilla Presence Index
The Pearson's Correlation of Tooth wear v/s Papilla Presence Index was found to be positively correlated (r = 0.6696), P < 0.0001 with 95% confidence interval (0.5295, 0.7741) which was seen to be statistically highly significant. Further the R-squared was 0.4484, i.e., change in tooth wear index contributed by Bleeding Index was 44.84%.

4 | DISCUSSION

The interdental papillae which fill the area between the teeth apical to their contact points play a major role by acting as a biological barrier and preventing bacterial invasion, and prevention of food impaction. A missing papilla is visible as a small triangular gap between adjacent teeth which often compromises the aesthetics.
Age and sex seem to modify the presence of the interdental papilla. Dental attrition that is caused by tooth to tooth contact is seen to have detrimental effects on the interdental papilla. It causes more plaque accumulation as it leads to reduced crown height which makes it difficult for the patient to maintain oral hygiene.

This study has been done to assess the effect of attrition on interdental papillary health in terms of Plaque index, Sulcus bleeding index and the level of interdental papillary height. It was observed that the mean Plaque index scores, Sulcus bleeding index scores and Papilla Presence index scores were significantly related to Tooth Wear.
According to a study done by Ioannou AL et al.[13] it was concluded that risk indicators for visible papillary absence, sex and age, need to be taken into consideration for careful assessment and meticulous treatment planning with respect to preservation of the interdental tissues.
A study done by Joshi K et al.[14] observed that complete papilla fill was associated with crown width: length ≥ 0.88. The observations of this study are similar to the results of our study. However Handelman CS et al.[6] concluded that tooth wear shortens the clinical crown, and therefore, the measure of clinical crown height can give a false negative result when gingival recession is present. The gingival margin-papillae measurement was not affected by tooth wear and gave a true positive result for gingival recession. It was seen that tooth wear (attrition) was not associated with an increase in gingival recession. The results of our study are in contrary to the observations of this study.
However various confounding factors like age, sex and parafunctional habits like bruxism could have influenced the results of the study which have not been taken into consideration and the sample size is not large enough to generalize the results.

3 | CONCLUSION

According to this study it can be concluded that Plaque index and Sulcus bleeding index measures and level of interdental papillary height is influenced by attrition. However larger sample size is required to generalise the results and several confounding factors could have influenced the results of this study which have not been taken into consideration. Considering larger samples and addressing the confounding factors mentioned, a further study is required to generalize the results.

CONFLICT OF INTEREST
There are no conflicts of Interest

REFERENCES:

1. Takei HH. The interdental space. Dent Clin North Am. 1980;24:169–76.

2. Cohen B. Morphological Factors in the pathogenesis of the periodontal disease. Brit Den J. 1959;107:31–9.

3. Checchi L, Zelent ME, Rizzi GP, D'Achille C. Normality and pathology of the interdental papilla. Dent Cadmos. 1989 May 31;57(9):83-92, 95.

4. Singh VP, Uppoor AS, Nayak DG, Shah D. Black triangle dilemma and its management in esthetic dentistry. Dent Res J (Isfahan). 2013 May;10(3):296-301.

5. Chen MC, Liao YF, Chan CP, Ku YC, Pan WL, Tu YK. Factors influencing the presence of interproximal dental papillae between maxillary anterior teeth. J Periodontol. 2010 Feb;81(2):318-24.

6. Handelman CS, Eltink AP, BeGole E. Quantitative measures of gingival recession and the influence of gender, race, and attrition. Prog Orthod. 2018 Jan 29;19(1):5.

7. Yun-Qi Wu, Joseph A. Arsecularatne, Mark Hoffman, Attrition-corrosion of human dental enamel: A review, Biosurface and Biotribology, Volume 3, 2017, 196-210.

8. Hegde, Mithra N; Yelapure, Mahalaxmi; Honap, Manjiri N; Devadiga, Darshana. The Prevalence of Tooth Wear and its Associated Risk Factors in Indian South West Coastal Population: An Epidemiological Study. Journal of the International Clinical Dental Research Organization 10(1):p 23-26, Jan–Jun 2018.

9. Löe H. The Gingival Index, the Plaque Index and the Retention Index Systems. J Periodontol. 1967;38:610–16.

10. Mühlemann HR, Son S. Gingival sulcus bleeding--A leading symptom in initial gingivitis. Helv Odontol Acta. 1971 Oct;15(2):107-13.

11. Cardaropoli D, Re S, Corrente G. The Papilla Presence Index (PPI): a new system to assess interproximal papillary levels. Int J Periodontics Restorative Dent. 2004 Oct;24(5):488-92.

12. Hooper SM, Meredith N, Jagger DC. The development of a new index for measurement of incisal/occlusal tooth wear. J Oral Rehabil. 2004 Mar;31(3):206-12.

13. Ioannou AL, Koidou VP, Kamintzi GI, Hinrichs JE, Kotsakis GA, Romanos GE. Risk Indicators of Papillary Recession in the Anterior Maxilla. J Esthet Restor Dent. 2015 Nov-Dec;27(6):367-73.

14. Joshi K, Baiju CS, Khashu H, Bansal S, Maheswari IB. Clinical assessment of interdental papilla competency parameters in the esthetic zone. J Esthet Restor Dent. 2017 Jul 8;29(4):270-275.

ORIGINAL RESEARCH

An Atypical Chauffeur: Tongue Driven Wheelchair

Pradeepchandra K[1] | Sarandha DL[2] | Smitha Sharan[3] | Sreeharsha TV[4] | Brunda K[5] | Harshitha Alva[6] | Sujana S[7] | Monika N[8]

[1] Senior Lecturer, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[2] Professor and Head of Department, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[3] Reader, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[4] Reader, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[5,6] Reader, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

[7,8] Post Graduate Student, Department of Prosthodontics, Crown and Bride, Dayananda Sagar College of Dental Sciences, Bengaluru, Karnataka., India

Correspondence
Corresponding author Pradeepchandra K
Email: pradeepchandrak@dscds.edu.in

Present address
Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 111; Karnataka; India.

Abstract

The human body is a machine that enables living and performing various task. Once the functional ability is lost a vital part of life will be compromised. The loss of function may be due to various causes and can be unilateral/bilateral which can be localized to a part or generalized.[5] Various wheelchairs currently available in the market uses electrically powered wheelchairs to allow individuals to complete daily tasks with greater independence and community environments. One of the newer concept in this area is a tongue driven wheelchair system. The tongue as an operating system can be beneficial because unlike the feet and hands, which are connected by brain through spinal cord, the tongue and brain has a direct connection through cranial nerve that generally escapes damage in severe spinal cord injuries or neuromuscular disease.[2] Tongue being a strong muscle provides faster and accurate movements that do not require much concentration or effort. Paralyzed patients can move around independently with the tongue driven wheelchairs creating a huge demand for this assistive technology in future. Further research in the field can make mobility far more accessible to people who are facing various challenges.

KEYWORDS
Chauffeur, Toung Wheelchair

1 | INTRODUCTION

The ability to move about freely, brings a sense of freedom to all. The loss of it can greatly impact a person's life. The loss of function of limb/limbs can be due to various causes. The most common causes leading to amputation are diabetes mellitus, peripheral vascular disease, neuropathy, and trauma.1

According to the World Health Organizations report on disability, currently about 15% of world population lives with some type of disability out of which 2-4 % of the population experience significant difficulties in their day-to-day activities. Wheelchair usage is not just limited to paralyzed people but also blind, physically handicapped and people having neuromuscular and spinal cord issues.2

Current modalities

There are currently multiple variants of wheelchairs available in the market. This includes the manual wheelchair.

1.   Manual wheelchairs are great for people who can operate them independently. However, the downside is that users can quickly become fatigued especially if they travel long distances or move around for an extended period of time on their own.3

2.   Powered wheelchairs have undergone an enormous change in the last decade. The development of micro processing capabilities allowed developers of powered mobility technology to include a wide range of functions in these devices.3 A motorized wheelchair like this resolves the issue of fatigue as well as disabilities that restrict the use of manually operated wheelchairs.

•   Joystick controlled wheelchair is one of these modalities. A joystick mounted on the wheelchair helps maneuver it around.

•   Another is the touchpad-controlled wheelchair. Touchpads feel similar to what you may find on a computer for controlling its mouse cursor. Touchpads can be configured for the user so that touching a specific part of the touchpad relative to the center will move in that direction. One drawback of both these technologies is that it is only accessible to those with coordinated motor functions.7

•   Switch coordinated wheelchairs are also available in the market. Switches can be mechanical momentary contact switches or based on proximity where no physical contact is required. Multiple switches can be used, one for each direction, three switches as in a head array or a single switch that is used with some scanning display.

•   Another alternative is the sip and puff mechanism wheelchair, which are operated by sucking and blowing on a mouthpiece. They require quite a bit of practice by the user to get good at driving.

•   Eye movement activated and voice-controlled wheelchairs are also available. But the mechanism can be misled by rogue eye movements or voice commands.7

2 | MATERIALS AND METHODS

The alternative wheelchair system that will be discussed in this article is the tongue driven wheelchair system [TDS].6 It is controlled via a prosthesis incorporated with touch sensors placed on the palate, and operated by the tongue movements. The prosthesis can be customized according to the dentulous state of the patient, if the patient is completely edentulous then the controller can be adapted to the complete denture prosthesis

And if the patient is partially edentulous then the controller can be incorporated into the Removable partial denture via clasp mechanism. In case of completely dentulous patients, the controller can be adapted onto a prosthesis adapted to the palatal aspect of maxilla via clasp retention mechanism.

The patient is advised to wear the prosthesis during the operation of wheelchair.

1.   End-to-End Working Model of the prototype:

The end-to-end working model of the tongue-controlled wheelchair involves various components seamlessly working together. The user's tongue movements are captured by the touch sensors placed in the upper jaw (figure 1). These touch sensors detect the tongue's position and send signals to the microcontroller, specifically the ESP32. The microcontroller processes these signals and determines the desired direction or action for the wheelchair. It then controls the DC motors, which are connected to the 3D printed wheels of the wheelchair (figure 2), through the L293D motor driver. By adjusting the motor speed and direction, the wheelchair moves according to the user's tongue movements. The microcontroller also interacts with other parts of the wheelchair, such as the chassis and chair, to ensure a holistic functioning system.
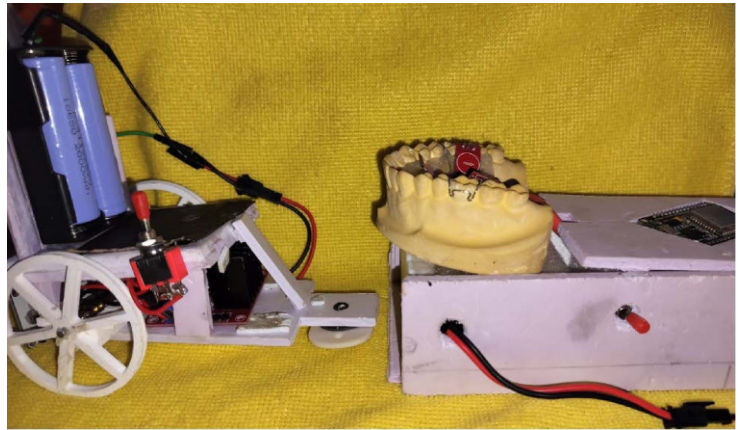
The complete setup of the prototype is depicted in figure 3
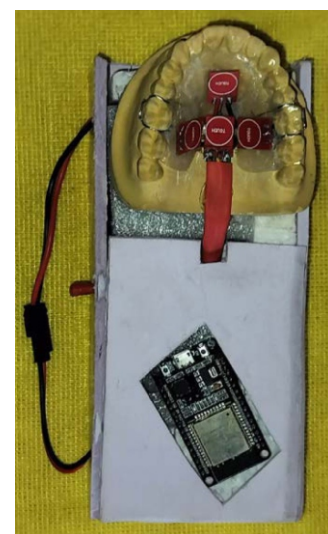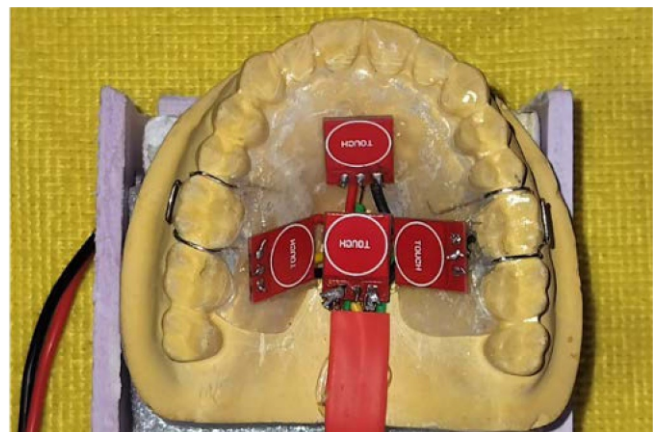
(Figure 1 – touch sensors placed on the palatal prosthesis)
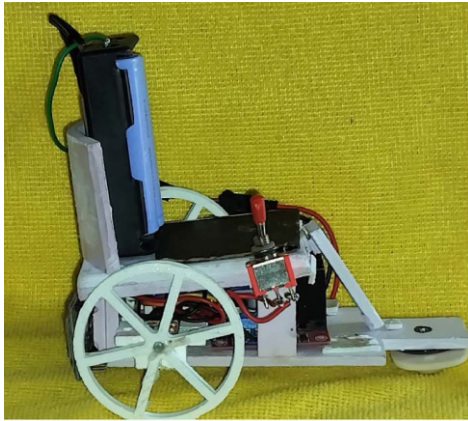
(Figure 2 – 3D printer wheelchair with DC motor)

(Figure 3 – complete prototype set up)

2.   Microcontroller Used in this prototype and its Significance:
The ESP32 microcontroller is selected for its suitability in IoT (Internet of Things) applications. It offers built-in Wi-Fi and Bluetooth connectivity, enabling wireless communication and control. The ESP32's ample processing power and memory make it capable of handling sensor inputs and effectively controlling the motors. Additionally, its abundant GPIO pins allow for seamless integration with various components of the wheelchair, including the touch sensors, motor driver, and other peripherals. By utilizing the ESP32 microcontroller, the tongue-controlled wheelchair can achieve efficient and reliable performance.

3.   Sensors Used and their Significance:
In the development of tongue-controlled wheelchairs, the choice of sensors plays a crucial role in achieving a wire-free setup. While touch sensors typically require wires to come out of the mouth, alternative sensor methods offer the possibility of a non-intrusive and comfortable solution. This document explores various alternative sensor approaches that eliminate the need for wires inside the mouth. Additionally, it provides reasons for utilizing touch sensors in cases where wires are necessary.

External Mounting:
Rather than placing sensors inside the mouth, an external mounting approach can be adopted. Touch sensors can be integrated into a custom-designed mouthpiece or attached to a wearable device positioned on the palate. This allows for close proximity to the tongue while routing wires externally, providing a wire-free experience for the user.

Other type of sensors available
•   Inductive Coupling:
Inductive coupling enables wireless power transfer. Touch sensors can be powered wirelessly using electromagnetic induction, with the power source located outside the mouth. Through a coil or magnetic field, the sensors receive power without the need for power wires. However, some form of wired communication may still be required for transmitting the touch data.

•   Infrared (IR) Sensors:
Infrared sensors can detect tongue movements without physical contact. Placed outside the mouth, these sensors capture the reflection or emission of infrared light from the tongue. The detected signals can be translated into control commands for the wheelchair, offering a wire-free and non-intrusive solution.

•   Optical Sensors:
Optical sensors, such as photodiodes or optical proximity sensors, analyze light changes to detect tongue movements. Positioned externally near the upper jaw, these sensors detect alterations in light when the tongue obstructs or reflects it. This wire-free method accurately captures tongue movements while maintaining user comfort.

•   Magnetic Sensors:
By utilizing magnetic sensors like Hall Effect or magneto resistive sensors, tongue movements can be detected through variations in the magnetic field. A small magnet placed on the tongue interacts with the externally positioned sensors, translating the changes into control commands. This approach eliminates the need for wires inside the mouth.

•   Ultrasonic Sensors:
Ultrasonic sensors measure the distance between the tongue and the sensor by emitting and analyzing reflected ultrasonic waves. These sensors, positioned externally, allow for wire-free implementation. By accurately determining tongue position and movement, they enable precise control of the wheelchair.

Reason for Using Touch Sensors:
The decision to use touch sensors, despite the wires required, can be justified based on cost-effectiveness, simplicity, and user-friendliness. Touch sensors are readily available, cost-efficient, and provide immediate response. These factors make them suitable for projects with limited resources or tight timeframes, where a wire-free setup is not a critical requirement.

In the quest for a wire-free setup in tongue-controlled wheelchair projects, alternative sensor methods offer viable solutions. Through external mounting, inductive coupling, infrared, optical, magnetic, or ultrasonic sensors, it is possible to eliminate the need for wires inside the mouth. However, touch sensors remain a practical choice in scenarios where wires are inevitable, considering their accessibility, affordability, and ease of implementation.

The touch sensors, placed in the upper jaw, play a crucial role in capturing tongue movements. These touch sensors are preferred due to their simplicity, affordability, and ease of implementation. They detect the presence or absence of tongue contact, providing reliable input for controlling the wheelchair.

Touch sensors are often cost-effective, readily available, and offer simplified implementation. This makes them an accessible option, particularly for projects with budget constraints or those requiring quick prototyping.

Additionally, the wheelchair may incorporate other sensors relevant to the specific requirements of the application, such as distance sensors or obstacle detection sensors. These additional sensors enhance the overall functionality and safety of the wheelchair.

4.   Implementation in Real Scenario and User Enable/Disable:

In a real scenario, the tongue-controlled wheelchair would involve integrating the system into a commercially available wheelchair with a suitable chair for the user's comfort. The wheelchair's existing chassis provides the necessary structural support and maneuverability. The touch sensors would be strategically placed on the palate, allowing the user to control the wheelchair through tongue movements.

To enable or disable the tongue-controlled functionality, a user-friendly interface can be incorporated into the wheelchair design. This interface may include buttons, switches, or touch-sensitive controls conveniently located within reach of the user. By engaging or disengaging this control mechanism, the user can activate or deactivate the tongue-controlled feature of the wheelchair.

Proper safety measures should be implemented to ensure the user's well-being. For example, an emergency stop button or lever can be included to immediately halt the wheelchair's movement in case of any unforeseen circumstances or emergencies. Additionally, the wheelchair can have manual control options, such as traditional joystick controls, allowing the user to switch between different control modes based on their preference or specific situation.

By integrating the tongue-controlled system into a real wheelchair, it becomes a practical and functional solution for individuals with limited mobility. The user can easily enable or disable the tongue-controlled feature as needed, ensuring a personalized and adaptable wheelchair experience while maintaining safety and convenience.

3 | RESULTS

The prototype was adapted with four sensors denoting forward, backward, right and left movements. Several motion tests were done to check the efficiency of sensors in bringing about motion in the desired directions. The results obtained showed successful range of movements.

4 | DISCUSSION

The use of evolving technology to improve the quality of life of individuals is being done at an accelerated rate in recent times. The results we have obtained from using sensors adapted on a palatal prosthesis have been encouraging. The basic movements of forward, reverse and right and left movements were appropriately followed in the model. As the model uses Bluetooth connection between the sensor and the wheelchair there is no clunky connective components.

Additionally, the wheelchair may be incorporated with other type of sensors (distance sensors or obstacle detection sensors) relevant to the specific requirements of the application. These additional sensors enhance the overall functionality and safety of the wheelchair.

This signifies the potential that similar technology can be utilized to make a full-scale version adapted to a wheelchair that will successfully function in the intended manner. This could provide a new alternative version of a powered wheelchair.

5 | CONCLUSION

The tongue drive wheelchair can be utilized by all people with disabilities to achieve the freedom to move around independently. This system has the potential to be more versatile in its applicability and offer more comfort during its usage. It is a compact system with a slight learning curve involved in adapting to its usage.

Conflict of Interest

The Authors declare no conflicts of interest

REFERENCES:

1. Omkar Raut, Vaibhav Soman, Navanath Shinde, et.al, Tongue Controlled Wheelchair, International Journal of Creative Research Thoughts,2018.

2. Diab, Mohamad, Tongue drive wheelchair. International Journal of Computational and Cognition, 2012.

3. Shwetha V, Hamsalekha V, "tongue-controlled wheelchair", International Journal of Research Publication and Reviews, July 2022

4. Huo X, Cheng C, Ghovanloo M. et.al, Evaluation of the tongue drive system by individuals with high-level spinal cord injury. Annu Int Conf IEEE Eng Med Biol Soc. 2009.

5. World Health Organization "World report on Disability"

6. Johnson AN,Huo X, GhovanlooM, ,Dual-task motor performance with a tongue -operated assistive technology compared with hand operations. J NeuEng and Rehab, 2012.

7. Monika Jain International Journal of Latest Trends in Engineering and Technology (IJLTET) (2013 -14)

8. Mohamad O.Diab , Nizar Awar , Abdul Aziz Al-Hojairi, et.al, Tongue Drive Wheelchair, international journal of computational cognition.

CASE REPORTS

Aesthetic Management of Anterior Midline Diastema with Direct Resin Composites- A Case Report

Amreen Firdose[1] | Vedavathi B[2] | Varada R Hiremath[3] | Akshata J Airsang[4] | Harsh Shrey[5]

[1,5]Post Graduate Student, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[2]Professor and Head of Department, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[3]Professor, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[3]Senior Lecturer, Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Karnataka, India

Correspondence

Corresponding author: Vedavathi B

Email: vedavathib@dscds.edu.in

Present address

Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 078, Karnataka, India

Abstract

Midline diastema is a common complaint in patients seeking aesthetic dental procedures. The max-illa has shown to have a higher prevalence of midline diastema than mandible. Various physiological and pathological factors can lead to midline diastema. These include the presence of a high labial fre-nal attachment, microdontia, habits such as finger sucking, tongue thrusting, or lip sucking, dental malformations, dental-skeletal discrepancies, and imperfect coalescence of the interdental septum. Selection of the technique and material for an effective treatment are usually dictated by time, phys-ical, psychological and economical limitations of the patient. Direct composite resins in diastema cases allow dentist and patient complete control of these limitations and formation of an aestheti-cally pleasing and natural smile. This article presents the aesthetic rehabilitation of anterior midline diastema with direct composite resin using the putty index technique.

K E Y W O R D S

Aesthetic Dentistry, Diastema, Direct Composite Resin, Putty Index Method

1 | INTRODUCTION

Maxillary anterior spacing or diastema is one of the common aesthetic complaint among patients.[1] It has been described as spacing between the proximal surfaces of adjacent teeth in the anterior midline mea-suring > 0.5 mm.[2] The incidence of true maxillary midline diastema is (SI1.6%) more than that of true mandibular midline diastemas (SI0.3%).[3] The aetiology of midline diastema is multifactorial, causes being physi-ological and/ or pathological in nature such as high frenal attachment, incomplete coalescence of the interdental septum, microdontia, pres-ence of a mesiodens or peg-shaped lateral incisors, congenital absence of lateral incisors, pathologies (e.g., cysts in the midline region), habits such as tongue thrusting, and/or lip sucking, discrepancy in the den-tal and skeletal parameters, and genetics.[4] Based on the etiology, the treatment plan may include a multi-disciplinary approach or the clo-sure of the space using direct and/or indirect restorative materials.

This further depends on the alignment and dimensions of the teeth being restored.[5] Hence, the assessment of tooth size and distribution of the space manually or using digital smile designing becomes an important tool in providing a natural smile.

The composite resins used for anterior restorations must exhibit good aesthetic characteristics. Availability of composite resins with superior mechanical properties and excellent polishability allows the clinician to mimic the natural dentition as well as renders a long-lasting restoration to the patient. Nanohybrid composites are hybrid resin composites with nanofiller in a pre-polymerized filler form, re-cently launched, that involve a combination of high initial polishing and supreme polish and gloss retention.[6] Additionally, composite resin allows a conservative treatment and offer quicker results.[7]

The use of putty index technique aids in acquiring a predictable an-terior composite build up. This technique uses an impression of the diagnostic mock up to produce a palatal silicone index. This can be then used to transfer the required anatomy into the mouth during treatment further improving the treatment outcome.[8] This case report describes a direct aesthetic midline diastema closure using putty index technique.

Abbreviations: ANA, anti-nuclear antibodies; APC, antigen-presenting cells; IRF, interferon regulatory factor.

2 | CASE REPORT

A 32-year-old male patient reported to the Department with the chief complaint of spacing in the upper front tooth region. The patient stated that the spacing was causing him social embarrassment and lowering his self-esteem. Patient had no associated symptoms, relevant past dental or medical history. The intraoral examination revealed the presence of midline diastema between maxillary central incisors (3.5mm) secondary to tongue thrust habit confirmed by performing clinical tests (Fig 1) and spacing between the mandibular incisors. On radiographic examination no evident pathologies were detected. The first line of treatment sug-gested to the patient was to undergo orthodontic treatment for closure of the diastema and spacing between the mandibular incisors. How-ever, as the patient was not willing for the same and wished for a faster and conservative approach, direct composite restorations for midline closure of midline diastema diastema using a direct composite build up using putty index was planned. Lower teeth spacing was not addressed as pa-tient for not willing for the same. Informed consent from the patient was taken, and complete treatment plan was discussed with the patient. In first appointment, diagnostic impression and cast were made. Following the dental analysis of the patient, diagnostic wax up done on the cast (Fig 2 (a)) and a putty index was created (Fig 2 (b)). The fit of the putty index in the mouth was confirmed.

Following oral prophylaxis, shade selection was done using button technique under natural daylight (Fig 3 (a)and (b)). A1 shade of Filtek™ Z350 XT (3M/ESPE, St. Paul, MN, USA) was selected. Split-dam tech-nique was used to isolate the maxillary teeth as the conventional rubber dam placement technique hindered the placement of the putty index palatally. In order to simulate natural A1 shade outlook, the shade A1 dentine and A3 enamel composite resin (Filtek Z350, 3M/ESPE, St. Paul, MN, USA) were used as layers. No preparation was done on the tooth surface prior to restoration. (SI37%) phosphoric acid (Etching Gel, Kerr, USA) was applied on the mesial surface of both the central incisors to be restored for 15 seconds, rinsed for 20 seconds, and dried with oil-free air (Fig 3 (c)). Then, two coats of a single bottle bonding agent (One Coat Bond SL Coltene, Switzerland) were applied using applicator tips (Fig 3 (d)) and cured for 20 seconds with an LED light (Bluephase N MC, Ivoclar Vivadent, Schaan, Lichtenstein). Care was taken to apply uniform coats of the bonding agent on the proximal tooth surfaces especially near the gingival area since pooling of the bonding agent may compro-mise the solvent evaporation, after careful application of the bonding agent near the sulcus, it was air-thinned using a three-way syringe. A thin layer of A3 shade composite resin was placed palatally on the putty index as enamel and placed into patient's mouth and cured for 40 seconds. A palatal shell of composite bonded to the tooth was formed by carefully removing putty index (Fig 3 (e)) which served as a reference for further placement of composite.

A1 dentine shade was placed in increments and manually contoured over the mesial surface of both the incisors using a long bladed tita-nium instrument. Posterior sectional matrix system was used to build the proximal surface of the teeth. A thin layer of A3 shade was used as the top enamel layer. All increments were cured for 40 seconds, both from labial and palatal aspects. The occlusion was verified in both cen-tric and eccentric relations using an articulating paper. Gross finishing was done using Tungsten carbide bur 134 014 (16 flutes yellow band). Final finishing was done using Shofu Super snap rainbow kit (Shofu INC, Japan). CompoSite Fine polishing tips (Shofu INC, Japan) were used along with polishing paste (Platina Hi-Gloss Composite polishing paste, PrevestDenPro) for polishing. The patient was motivated to maintain oral hygiene and instructed to floss before tooth brushing regularly and to avoid pigmented liquids cause staining of restoration. The patient has been recalled after 6 months for follow up.

3 | DISCUSSION

Various treatment modalities are available for closure of midline di-astema such as orthodontic treatment, an indirect ceramic restoration, direct composite resins or an interdisciplinary approach.[7] Direct com-posite resins are indicated for minimal to moderate diastema closure and when preservation of tooth structure is a priority serving as the most conservative approach.[4,9] In this case report, a direct composite restoration was used for diastema closure as the patient was not will-ing to undergo an orthodontic treatment or habit correction and wished for a faster and conservative approach. However, the patient was made aware of the impermanence of such a closure as the aetiology was not address adequately during the treatment. Nonetheless, excellent out-comes have been reported by numerous authors who have used com-posite resins for diastema closures pertaining to the longevity (SI88%) up to 10 years) and aesthetic outcome of such restorations.[5,10,11] Highly aesthetic restorations made up of composite resins are now possible because of constant improvements in techniques, materials, and tech-nology. The introduction of nanometer-sized particles has been one of the latest developments in the field which is said to offer superior aes-thetics and polishability required for anterior restorations. Filtek Z350 (3M ESPE, St. Paul, MN, USA) employed in this case report, is nanocom-posite on the market that contains nanometric particles (nanomers) and nanoclusters (NCs). It shows high translucency, high polish and polish retention similar to those of micro-filled composites whilst maintain-ing the physical properties and wear resistance equivalent to those of several hybrid composites.[12] Successful restorations rely mostly on the effective control of moisture and saliva from the tooth being restored as contamination remains an important cause of bond failure. Therefore, rubber dam isolation was done in this case to prevent moisture contami-nation. A silicone putty index was used in this case as it perfectly defines the sagittal dimensions, the length, and the incisal edge position, incisal thickness, mesial and distal line angles of the required final restoration; it reduces the need for extensive final finishing and polishing procedures. Hence, the practitioner can fully target the application of composite lay-ers.8 Putty index technique is easy to perform, and it creates correct midline with optimal contact area. Additionally, this technique allows

Fig 1: Pre-operative intraoral image of patient with midline diastema; (a) Frontal view; (b) Right lateral view; (c) Left lateral view.
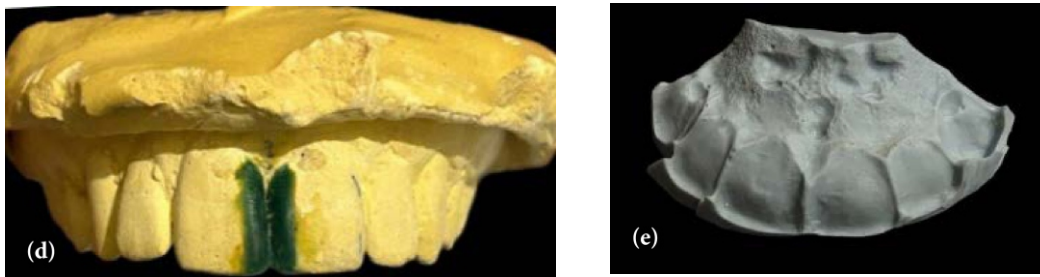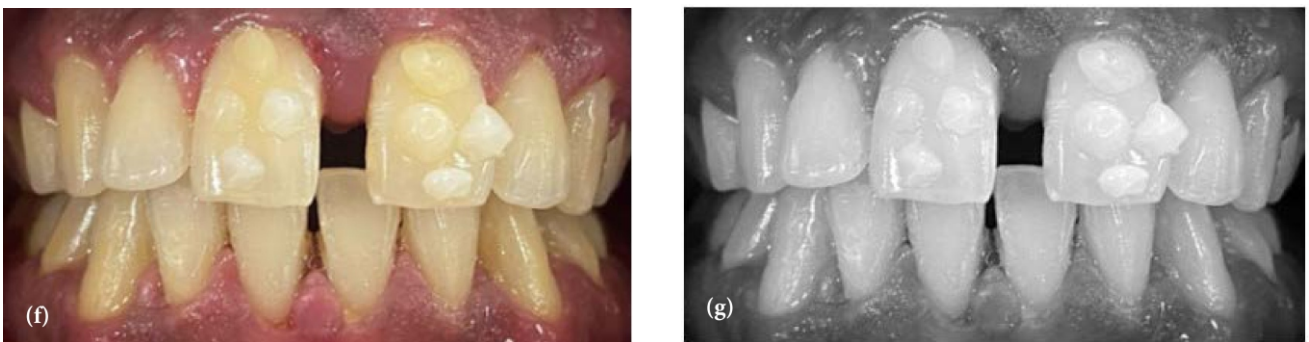

Fig 2: (a) Diagnostic mock up (b) Silicone putty index

the clinician in reproducing the palatal anatomy accurately overcoming the most challenging part of anterior restorations. Dual layering technique was used in this case to mimic the three-dimensional appearance of natural teeth. For an overall shade of A1, Dentine A1 and Enamel A3 was used in layers. However, there were certain limitations in the case presented such as the impermanence of diastema closure as the aeti-ology was not address adequately during the treatment. Furthermore, there are some distinct disadvantages of doing composite restorations. Dual layering technique was used in this case to mimic the three-dimensional appearance of natural teeth. For an overall shade of A1, Dentine A1 and Enamel A3 was used in layers. However, there were certain limitations in the case presented such as the impermanence of diastema closure as the aetiology was not address adequately during the treatment. Furthermore, there are some distinct disadvantages of doing composite restorations as they posses less colour stability compared to that of ceramics. This of course is related to the quality and degree of polishing but also depends on the patient maintenance.[13]

4 | CONCLUSION

The clinical outcome of this case report demonstrated that the putty index replicating the palatal region for composite restoration can be a reliable procedure for direct composite restorations. Nanohybrid composites can be used to provide an acceptable colour match along with a conservative approach. Though some disadvantages are noted, such as discolorations, when used judiciously, they can serve as the material of choice for patients with aesthetic problems of anterior teeth and with maintainable hygiene practice.

CONFLICT OF INTEREST

The Authors declare no Conflict of interest.

REFERENCES

1. K. Koora, M. S. Muthu, and P. V. Rathna, "Spontaneous closure of midline diastema following frenectomy," J Indian Soc Pedod Prev Dent. vol. 25, no. 1, pp. 23–26, 2007.

2. H. J. Keene, "Distribution of diastemas in the dentition of man," American Journal of Physical Anthropology, vol. 21, no. 4, pp. 437–441, 1963.

3. S M Hashim Nainar , " Incidence and etiology of midline diastema in a population in South India (Madras) " Angle Orthod. vol. 59, no. 4, pp. 277-282, 1998.

4. W. J. Huang and C. J. Creath, "The midline diastema: a review of its etiology and treatment," Pediatric Dentistry, vol. 17, no. 3, pp. 171–179, 1995.

5. S. Ardu and I. Krejci, "Biomimetic direct composite stratification technique for the restoration of anterior teeth," Quintessence International, vol. 37, no. 3, pp. 167–174, 2006.

6. Qaiser S, Devadiga D, Hegde MN. Esthetic Rehabilitation with Nanohybrid Composite: Case Report Series. J Adv Oral Res. 2020;11(2):251-6.

7. B. Bağış and H. Y. Bağış, "Porselen laminate veneerlerin klinik uygulama aşamaları: klinik bir olgu sunumu," Ankara Univ Hekim Fak Derg, vol. 33, no. 1, pp. 49–57, 2006.

8. Gupta, R., Miglani, A., Gandhi, A. et al. Esthetic Management of Diastema Closure: An Innovative Technique Utilizing Putty Index Method. IJOCR2018;6(1):104-108, 2018.

9. Biswas I, Post graduate trainee, Department of Conservative dentistry and Endodontics, Guru Nanak Institute of Dental Sciences and Research, Kolkata. Midline Diastema closure using direct light cured composite resin - a case series. Int J Adv Res 2019;7(4):1559-1566.

10. Kabbach W, Sampaio CS, Hirata R. Diastema closures: A novel technique to ensure dental proportion. J EsthetRestor Dent. 2018;30(4):275-280

11. R. E. Jordan, Esthetic Composite Bonding Techniques and Materials, Mosby-Year Book, St. Louis, Mo, USA, 2nd edition, 1993.

12. De Andrade, A. K. M., Duarte, R. M., Medeiros e Silva, et al., (2011). 30-Month randomised clinical trial to evaluate the clinical performance of a nanofill and a nanohybrid composite. Journal of Dentistry, 39(1), 8–15.

13. C. Willhite, "Diastema closure with freehand composite: controlling emergence contour," Quintessence International, vol. 36, no. 2, pp. 138–140, 2005.

Treatment of Skeletal Class II Malocclusion with Obstructive Sleep Apnoea using Orthodontic-Surgical Approach

Manas G[1] | Hemanth M[2] | Aravind M[3] | Afshan SW[4] | Prajwal Prabhu[5] | Kavya BR[6]

[1]Post Graduate Student, Department of Orthodontics and Dentofacial Orthopedics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[2]Professor and Head,Department of Orthodontics and Dentofacial Orthopedics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[3]Professor, Department of Orthodontics and Dentofacial Orthopedics, Dayananda Sagar College of Dental Sciences, Karnataka, India

[4,5,6]Senior Lecturer,Department of Orthodontics and Dentofacial Orthopedics, Dayananda Sagar College of Dental Sciences, Karnataka, India

Correspondence
Corresponding author: Afshan SW
Email: afshansw@dscds.edu.in

Present address
Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 078, Karnataka, India

Abstract

In the treatment of skeletal class II malocclusion due to retrognathic mandible, the airway should be considered for the progress and outcome of the treatment. Here we present a case of 30 year old male patient having convex profile with potentially incompetent lips, class II skeletal base with maxillary and mandibular dentoalveolar protrusion, crowding in the maxillary and mandibular arch. He had nocturnal choking, difficulty in breathing while lying down and snoring suggestive of obstructive sleep apnoea. The treatment involved orthodontic-surgical intervention to correct the Obstructive Sleep Apnoea. Bilateral sagittal split osteotomy (BSSO) advancement of 8mm and ge-nioplasty of 4mm was done. The post operative orthodontic treatment included settling the bite, monitoring the relapse, and managing the dental space for future.

KEYWORDS

Obstructive Sleep Apnoea (OSA); Class 2 Malocclusion; Hyperdivergent Facial Type; Bilateral Sagittal Split Osteotomy (BSSO)

1 | INTRODUCTION

Class II malocclusion is one of the commonest malocclusions and approximately 14.6% of Indians have this malocclusion. This can be due to a combination of factors such as a mandibular deficiency or maxillary excess or both.[1] The treatment involves the correction of jaw discrepancies using functional appliances for growth modification, camouflage using orthodontic therapy, a combination of both or surgical alternatives in non growing patients.

The dentoalveolar position in growing patients may change if functional appliances are used and cause remodelling of the condyles. In Class II adults with skeletal deformities, Orthodontic camouflage or surgical-orthodontic treatment are the standard methods for treating malocclusion. On the other hand, dental compensation is utilized in orthodontic camouflage therapy to conceal the skeletal disparity. Additionally, the skeletal deformity is corrected with jaw osteotomies that rotate counterclockwise and orthodontic detailing in the surgical-orthodontic option.[2] Because surgical-orthodontic therapy promotes greater advancement of the mandible and chin and less retraction of the upper teeth, it is more successful in preserving the upper lip profile.

As a result, patients with a more severe sagittal jawbone discrepancy, particularly those with mandible retrusion, typically undergo it. Notwithstanding the issues with oral function and appearance, patients with retrusive mandibles need to have their airway health taken into account. When an airway is narrow, a lateral cephalometric film evaluation is necessary. When the airway is significantly constricted, the Apnoea-Hypopnoea Index (AHI) and polysomnography (PSG) could be necessary to identify if obstructive sleep apnoea (OSA) is present.[3] This case re-port demonstrates the correction of skeletal Class II malocclusion due to retrusive mandible with am ortho-surgical treatment option.

2 | CASE REPORT

A 30-year-old male patient visited the department of orthodontics and dentofacial orthopedics with a chief complaint of forwardly placed upper front teeth, reduced chin size and difficulty in breathing while lying down, nocturnal choking and snoring. He is internally motivated with positive attitude towards orthodontic treatment. On physical examina-tion, he is moderately built with 168cms in height and weighs 64 kgs with mesomorphic body type. Patient had history of restless sleep, noc-turnal choking and witnessed apnoea during sleep. Patient has also undergone sleep-study with Somno Touch Resp.

2.1 | Clinical Examination

Extra-Oral Examination: There was no evidence of facial asymmetry in the frontal view. The individual had obvious lip incompetence accompanied by a prominent show of upper teeth. His upper dental midline was aligned with facial midline, mesocephalic head, mesoproscopic face, potentially incompetent lips, consonant smile, incisor exposure on smile 7mm width, no gingival exposure on smiling and a mesorrhine nose. In profile view, patient had a convex facial profile with an increased Frankfurt's mandibular plane angle (FMPA), increased lower facial height, straight nasal dorsum with average nasolabial angle, negative lip step, deep mentolabial sulcus, receding chin and a double chin appearance.(Fig. 1)

Fig.1: Pre-Treatment Extra Oral Photos

Intra-Oral Examination: On intra-oral examination, the teeth 35, 36, and 46 were missing and hence the molar relationship could not be established. The canine relationship and buccal segment were Class II on the right, end on left side with a deep bite and increased overjet (the overjet measured 9mm, while the overbite measured 6mm) . 16 and 47 were mesially tilted. The patient had a cross bite in relation to 27. The lower dental arch was ovoid and symmetric, while the upper arch was tapered and symmetric. Overall, the patient had satisfactory periodontal health. Spacing was present in upper and lower arch. (Fig.2)

Fig.2: Pre-treatment Intra Oral photo

2.2 | Summary of Respiratory Analysis

Increased Respiratory Effort-Related Arousals (RERA): The individual experiences a higher frequency of Respiratory Effort-Related Arousals, indicating disruptions in sleep due to respiratory events. Desaturation to 85%: Oxygen saturation levels drop to 85%, suggesting significant episodes of oxygen desaturation during sleep. This is a critical concern as it may lead to hypoxemia. Snoring: The presence of snoring indicates potential airway obstruction or restriction during sleep, contributing to respiratory disturbances.

2.3 | Radiographic Findings

OPG reveals a Permanent set of Dentition, missing 36,35,46.
Root canal Treated 17. Restored 17. Mesio-angularly tilted 47.

Fig.3: Pre-treatment OPG

2.4 | Cephalometric Findings

On examination of lateral cephalograph (Fig.4), the patient exhibits a Class II skeletal jaw base with posterior divergence, ANB angle 7°, an increased mandibular plane angle of 42 degrees. A vertical growth pattern with increased lower anterior facial height. Both the upper and lower pharyngeal airways are reduced in size. The upper pharynx measures at -14 mm (normal range: 15-20 mm).

Fig.4: Pre-treatment Cephalograph

The lower pharynx measures at -6 mm (normal range: 11-14 mm). A decrease in mandibular corpus size by 6 mm is noted. The Wits appraisal measures 5 mm, indicating the degree of maxillary and mandibular discrepancy. Schwarz analysis reveals a maxilla to mandible ratio of 2.14:2.86, signifying an increased maxilla and decreased mandible. Maxillary size is decreased by 2.6 mm, and mandible size is decreased by 5 mm.

The patient exhibits a vertical growth pattern, with the maxilla and mandible diverging anteriorly. SN-GO-GN angle is 45°, FMA is 42°, indicating a vertical growth pattern. The Jaraback Ratio is 61%, confirming a vertical growth pattern. Upper and lower gonial angles are 45° and 90°, respectively. Basal plane angle is 43°.The J Angle is 85°. N-ANS measures 46 mm, indicating a decreased middle third of the face by 5 mm. U1 to NF shows extruded incisors by 3 mm. U6 – NF reveals extruded upper molars by 2 mm and intruded lower molars by 2mm. Soft Tissue Relation: The patient has an average nasolabial angle. A deep mentolabial sulcus is observed. Upper lip thickness is 14 mm and lip strain is 3 mm. Lower lip thickness is 14 mm, and lower lip length is 54 mm. The soft tissue profile angle is 148°, indicative of a Class II soft tissue profile. The total soft tissue profile angle is 124°, confirming a Class II profile. The soft tissue facial angle is 79°, consistent with a Class II soft tissue profile.

2.5 | Diagnosis

A 30-year-old, male patient reported to the department of orthodontic and dentofacial orthopedics with a chief complaint of forwardly placed upper front teeth, reduced chin size and difficulty in breathing while lying down, nocturnal choking and snoring. Skeletally, the patient exhibits a Class II maxilla-mandibular relation with soft tissues matching. Patient has a vertical growth pattern and increased lower anterior facial height, decreased mandibular corpus size with divergent jaw bases. Patient had a Class II incisor and canine relation, proclined upper incisors and lower incisors, lower anterior crowding, increased overjet and overbite. Soft tissue features included a convex facial profile, average nasolabial angle, reduced chin thickness, protruded and incompetent lips, obtuse chin throat angle, double chin appearance, and a deep mentolabial sulcus.

PROBLEM LIST Class II maxillo mandibular relation with convex facial profile, vertical growth pattern, incompetent and protruded lips decreased upper and lower pharyngeal airway, double chin appearance, class II incisor and class II canine relation, missing 46,36,35, increased overjet and overbite and crowding in relation to upper and lower interi-ors and proclined upper incisors. The aims and objectives of treatment were to correct skeletal class II base, recessive mandible, proclined upper and lower anteriors. To achieve ideal overjet and over bite and prosthetic rehabilitate 35. To achieve class I molar canine and incisor relation, a pleasing soft tissue profile and ideal dimension of pharyngeal airway.

TREATMENT PLAN 1. Presurgical phase: The orthodontic treatment was initiated with fixed appliance using 0.022 × 0.028 MBT prescription along with a non-extraction protocol. The levelling and alignment was initiated using 014 Niti followed by ,016 niti,018 niti,17x25 niti,19x25 niti,19x25 stainlesss steel wires for both the arches. (Fig. 5,6,7). the arches were stabilized using SS wires (Fig.8). Mock surgery was per-formed (Fig. 9) and pre surgical splints were fabricated 2. Surgical phase: Surgical correction was planned by Bilateral Sagittal Split Osteotomy advancement of 6mm followed by rotational genioplasty (Fig. 10).

3. Postsurgical phase: Post surgical orthodontics was continued after surgery to close residual spaces and finishing and detailing was done. Settling was initiated with intermaxillary elastics to improve the occlusion and neuromuscular function. (Fig.11)

Fig. 5: Levelling and alignment using 0.016 NiTi

Fig. 6: Levelling and alignment 0.017x 0.025 NiTi

Fig. 7: 0.019x 0.025 Stainless Steel

Fig. 8: Arches stabilized

Fig. 9:Mock surgery

Fig. 10:Surgical phase - BSSO advancement surgery & Rotational genioplasty

Fig.11: Post Surgical Photos

T A B L E 1 Cephalometric Analysis.

Variable	Pre-Treatment	Post-Surgical
SNA	77	81 1
SNB	70	79 1
ANB	7	2 1
Wits Appraisal	5mm	2mm 1
Upper Incisor to Sn	103	102 1
Lower Incisor to Mandibular Plane	97	100 1
Interincisal angle	111	107 1
Maxillary Mandibular Plane angle	43	44 1
Upper anterior facial height	46	51mm 1
Lower anterior facial height	75	77mm 1
Jarabak Ratio	61.5	60 1
Lower incisor to A Pog Line	+10mm	+9mm 1
Lower Lip to Ricketts E Plane	+4mm	+4mm 1

Fig.12: Post debonding photos (extraoral)

Fig.13: Post debonding photos (intraoral)

3 | RESULTS

The assessment of this case showed well-aligned dentition. Extraorally, the patient demonstrated a well-balanced facial profile and competent lips (Fig.12). The cephalometric analysis [Table 1] pre and post surgery showed improved parameters and harmonious occlusion. Intra-orally post surgery (Fig.13) patient had a good occlusion and Implant prosthetic rehabilitation of 37 is planned to achieve bilateral class 1 molar relation and for the better settling of the posterior occlusion. The retention protocol consisted of a fixed lingual retainer in the lower arch and a Beggs wrap around retainer in the maxillary arch. The treatment duration consisted of 24 months and the patient was highly satisfied with the results of the treatment.

4 | DISCUSSION

A large percentage of orthodontic patients have skeletal class II malocclusion. The only options for adults with skeletal class II are surgery or camouflage.

Even though the primary reason these patients visit is for cosmetic purposes, a deficient mandible, which is an underlying craniofacial abnormality, frequently acts as a significant risk factor for sleep apnoea or breathing disorders during sleep. The likelihood that airway issues will arise in the future and the impact of treatment on the airway should be taken into account when planning the treatment strategy.[4] The Sleep Questionnaire (FOSQ) is a screening tool used for diagnosis of sleep disorders related to breathing. This self-report measure was initially described by Weaver et al. to evaluate the effects of excessive sleep disorders on a variety of daily routine activities, including general activity level, attentiveness etc.[5] For treating OSA, CPAP therapy is considered the gold standard.[6] In addition, candidate cases may be given consideration for soft tissue surgical procedures such as adenotonsillectomy, nasal, palatal, and tongue surgeries.[7] Specifically, maxillomandibular advancement (MMA) was the primary skeletal correction because it could enhance his airway volume and facial profile at the same time. Given the patient's profile and primary complaint, Orthognathic Surgery is regarded as the primary treatment strategy in this case. The patient's airway space widened significantly overall with advancement.[8] Stability during surgery is influenced by the direction of movement, the kind of fixation, the kind of surgical technique, and muscle adaptation.[9] Proffit et al. states that when a patient has rigid internal fixation and their anterior facial height is maintained or increased, the maxilla tends to move upward.[10] Patients with Class II malocclusion experience relapses of surgery in advancements greater than 10 mm. to certain research, the surgical correction of mandible is associated with elongation of the suprahyoid muscle and extension of the pterygomasseteric sling in patients with skeletal Class II malocclusion and high MPA. This may also increase the risk of surgical recurrence. The maxilla was impactioned and rotated counterclockwise as a result of the surgery. These modifications were comparable.[11] Overall, there is still room for improvement in a few areas, like the obvious notching at mandibular margin, a typical sagittal osteotomy side effect progression of the jaw. Lingual proximal segment or ante gonial notch split, thin mandible etc. This can be handled later by another procedure involving lipofilling or bone grafts. An additional factor is that the lip posture was sagging at the bilateral cheilion, providing the patient with a frowny expression whenever he wasn't smiling. The muscle traction may have been the cause of this. During the mandibular advancement, the depressor anguli oris muscle, which originates from the external oblique line, may change in length and rotation in a counterclockwise direction. The hyperactive state of the perioral muscle may cause a frowny expression on one's face.

One could inject type A botulinum toxin to relax these muscles. Consulting with a plastic surgeon can help to alleviate this issue.

5 | CONCLUSION

Because a retrusive mandible frequently causes airway problems, the airway condition needs to be taken into consideration for patients with skeletal Class II who have a retrognathic mandible in addition to aesthetic and functional goals. Additionally, CBCT or an X-ray can be used to confirm the condylar anatomy and assess the likelihood of a relapse following Class II surgical-orthodontic treatment. It may be necessary to overcorrect mandibular advancement in order to make up for the airway patency and skeletal relapse.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES:

1. Sandhu, Sarabjeet & Bansal, Nidhi & Sandhu, Navreet. (2012).Incidence of Malocclusions in India -A Review. J Oral Health CommDent. 6. 21-24. 10.5005/johcd-6-1-21.

2. StatPearls: Obstructive sleep-disordered breathing. (2022). Accessed: September 27,2022

3. Chang HP, Chen YF, Du JK: Obstructive sleep apnea treatment in adults. Kaohsiung J Med Sci. 2020, 36:7-12. 10.1002/kjm2.12130

4. Bailey LJ, Proffit WR.Combined surgical and orthodontic treatment. In:Proffit WR, Fields HW Jr., ed ors. Contemporary Orthodontics. 3rd ed. St. Louis, MO: Mosby; 1999. p. 674-709

5. Weaver TE, Laizner AM, Evans LK, Maislin G, Chugh DK, Lyon K, Smith PL, Schwartz AR, Redline S, Pack AI, Dinges DF.An instrument to measure functional status outcomes for disorders of excessive sleepiness. Sleep. 1997 Oct;20(10):835-43. PMID: 9415942.

6. Paes EC, van Nunen DP, Basart H, et al. "Management of Neonates with Severe Airway Obstruction due to Pierre Robin Sequence: A Systematic Review of the Literature." Pediatr Pulmonol. 2013;48(5):520-527.

7. J Paunonen M Helminen T Peltomaki Long term stability of mandibular advancement with bilateral sagittal surgeryJ Cranio-Maxillary Surg201846914216

8. Muto T, Yamazaki A, Takeda S. A cephalometric evaluation of the pharyngeal airway space in patients with mandibular retrognathia and prognathia, and normal subjects. Int J Oral Maxillofac Surg 2008;37:228- 231.Proffit WR, Turvey TA, 12.

9. D Mulier LG Romero A Führer C Martin S Shujaat E Shaheen Long term dental stability after orthognathic surgery:A Systematic ReviewEuropean J Orthod2021431104112

10. Mihalik CA, Proffit WR, Phillips C. Long-term follow-up of Class II adults treated with orthodontic camouflage: a comparison with orthognathic surgery outcomes. Am J Orthod Dentofacial Orthop 2003;123:266-278.

11. Phillips C. The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension. Head Face Med 2007;3:21

12. Baas Bjork A, Skieller V. "Growth of the maxilla in three dimensions as revealed radiographically by the implant method." Br J Orthod. 1977;4(2):53-6.

Middle Mesial Canal in Mandibular 1st Molar: Unravel the Hidden Anatomy

Harshitha VS[1] | **Ranjini MA[2]** | **Roopa R Nadig[3]**

[1]Post Graduate Student, Department of Conservative Dentistry Endodontics, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

[2]Reader, Department of Conservative Dentistry Endodontics, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

[3]Former Professor and Head of Department, Department of Conservative Dentistry Endodontics, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

Correspondence

Corresponding author Ranjini NA
Email: ranjinima@dscds.edu.in

Present address

Department of Conservative Dentistry and Endodontics, Dayananda Sagar College of Dental Sciences, Shavige Malleswara Hills, Kumaraswamy Layout, Bangalore 560 078, Karnataka; India.

Abstract

Endodontic treatment of mandibular molars is challenging because of variable root canal morphology. Thorough knowledge of the internal dental morphology is extremely important for effective cleaning and shaping the root canal system. The possibility of additional canals, should be explored with the aid of technologies such as magnification and illumination among others. Clinicians experience has also shown to be a key factor in negotiation and management of these aberrant canal configurations. This case report presents the treatment of a mandibular first molar with five root canals, of which three were located in the mesial root. A third canal was found between the mesiobuccal and mesiolingual root canals

KEYWORDS

Five Canals, Mandibular Second Molar, Middle Mesial Canal

1 | INTRODUCTION

The primary aim of endodontic therapy is complete debridement of the root canal system and three dimensional obturation of the same. Thorough knowledge of the internal dental morphology is important so as to identify aberrant anatomy of teeth pre-operatively. Permanent mandibular molars, which are the earliest posterior teeth to erupt, are the most commonly encountered type of tooth for endodontic treat-ment. Mandibular molars present usually as 2-rooted teeth with 2 canals in the mesial root and 1 or 2 canals in the distal root.[1,2]

During tooth maturation, secondary dentin apposition can cause ver-tical partitions within the root canal cavity, creating multiple canals. Similarly, a third root canal may be created within the root canal cavity of mandibular molars. Such third canals are situated centrally between the buccal and lingual root canals and exhibit relatively smaller diameter.[3] The probability of a fifth canal in mandibular first molars, is around 1–15%.[4] Vertucci and Williams were the first to report the middle mesial

canal in a mandibular molar.[5] Thereafter many case reports presented aberrant canal morphology in the mesial root. Magnification with loupes or microscope improves the visibility and thus helps in the detection of small hidden canals. The purpose of this article is to report the successful endodontic treatment in a mandibular molar with three mesial canals.

2 | CASE 1:

A 23-year-old female patient presented with a chief complaint of decayed tooth and associated pain in her left mandibular region for 2 weeks. History of presenting illness showed dull, continuous pain on chewing. On intraoral examination, deep carious lesion was present in 36. Tooth exhibited no mobility and was tender on vertical percus-sion. Her medical history was noncontributory. Periodontal probing was within the normal limit. Preoperative periapical radiograph revealed deep carious lesion involving pulp with widening of apical periodontal ligament space in 36[Fig:1]

The involved tooth gave exaggerated response to electric pulp tester in comparison to the contra-lateral tooth. A diagnosis of symptomatic irreversible pulpitis with symptomatic apical periodontitis was made for the involved tooth and endodontic therapy was planned. The goal of the treatment was to relieve pain through root canal treatment followed by suitable post endodontic restoration. After administration of local anesthesia with 2% lignocaine, dam isolation was done and all carious tissue was removed. An endodontic access prepa-ration was made. After pulp extirpation and copious irrigation of the pulp chamber, two distal and two mesial canal orifices were located. Using the dental loupes and endodontic explorer, a thorough examination of the groove between the mesiobuccal and mesiolingual canal orifices revealed the middle mesial canal orifice, that was subsequently negoti-ated with a size 6 K file [Fig 2]. The electronic apex locator was used to establish the working length that was confirmed with a radiograph. Radiographs taken at multiple angles showed independent mesiolingual canal and middle mesial canal confluent with mesiobuccal canal. The canals were initially instrumented with stainless steel K files up to size 20.

Irrigation was done with copious amounts of 3% sodium hypochlo-rite and 17% ethylene diaminetetraacetic acid with saline irrigation intermittently. Rotary instrumentation was carried with Neo-endo flex files till 25.4% for each canal and a master cone radiograph was taken [Fig 4]. After preparation, the canals were flushed with saline, dried with sterile paper points. Calcium hydroxide based intracanal medicament was given and temporized with cavit. At the subsequent visit after a week, the tooth was asymptomatic. The intracanal medicament was flushed out and the canals were irrigated with 17% EDTA for one minute. Saline was used as the final irrigant, canals were dried with paper points and obturated with gutta percha cones and zinc oxide eugenol-based

sealer. A post obturation radiograph was taken [Fig 6]. Appropriate post-endodontic restoration was performed in the subsequent visit, to
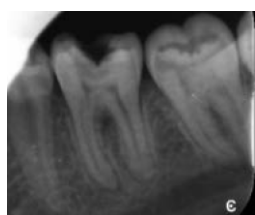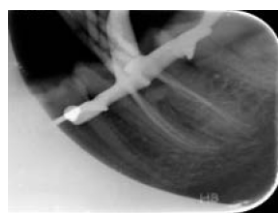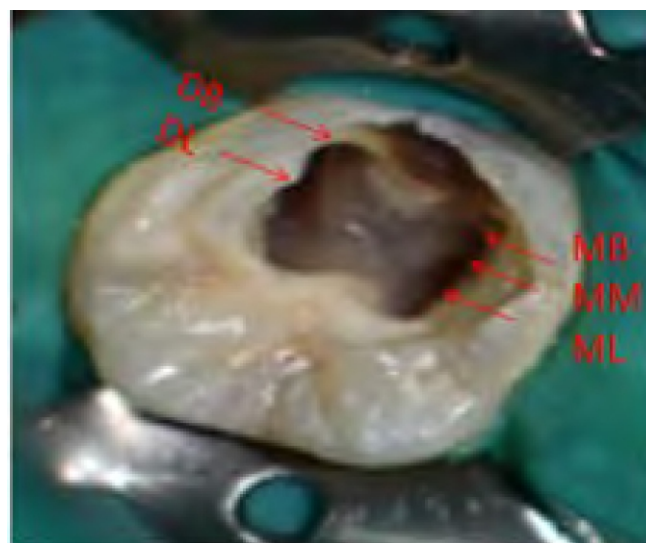
ensure an adequate coronal seal.

Fig 5: Canal orifices after cleaning and shaping

Fig 6: Post Obturation

Fig 7: 3 Months Follow-up

3 | CASE 2:

A 48-year-old male patient presented with a chief complaint of pain in his lower left back teeth region since past 1 month. On clinical examination, mandibular left first and second molar were tender to horizontal percussion and exhibited grade II mobility with abscess draining through the gingival sulcus. No relevant medical history was noted. Both the teeth were non carious, and showed no response to thermal or electrical pulp sensibility tests. Diagnosis of pulpal necrosis with symptomatic apical periodontitis in 36, 37 was established. Treatment plan was to perform endodontic treatment for 36, 37 followed by periodontal therapy for the same. On first appointment oral prophylaxis was done and local anesthesia was administered for root canal treatment of 36, 37. Access opening was done under rubber dam isolation. After pulp extirpation and copious irrigation of the pulp chamber, two distal and two mesial canal orifices were located in 36 and two mesial canals and one distal canal were located in 37. Using the dental loupes and endodontic explorer, a thorough examination of the groove between the mesiobuccal and mesiolingual canal orifices was done, which revealed the middle mesial canal orifice in 36 that was subsequently negotiated with a size 6 K file [Fig 9]. The electronic apex locator was used to establish the working length that was confirmed with a radiograph [Fig 10]. Radiographs taken at multiple angles showed independent mesiolingual canal and middle mesial canal confluent with mesiobuccal canal in tooth 36.

Fig 1: Pre-Operative IOPAR

Fig 2: Negotiated 3 mesial canals

Fig 3: Working Length

Fig 4: Master Cone Selection

The canals were initially instrumented with stainless steel K files up to size 20. Irrigation was done with copious amounts of 3% sodium hypochlorite and 17% ethylene diaminetetraacetic acid with saline irrigation intermittently. Rotary instrumentation was carried with ProTaper gold file till F2 for each canal and a master cone radiograph was taken [Fig 12]. After preparation, the canals were flushed with saline, dried with sterile paper points. Calcium hydroxide based intracanal medicament was given and temporized with cavit. At the subsequent visit after 2 months, the tooth was asymptomatic. The intracanal medicament was flushed out and the canals were irrigated with 17% EDTA for one minute. Saline was used as the final irrigant, canals were dried with paper points and obturated with gutta percha cones and AH plus sealer. A post obturation radiograph was taken [Fig 13]. Post endodontic restoration was done with composite resin. The patient was referred back to dept of periodontics for further periodontal therapy wrt 36 and 37.

Fig 8:

Fig 9:
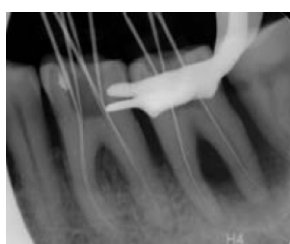
Fig 10:

Fig 11:

Fig 12:

Fig 13:

3 | DISCUSSION

This case report, presents the endodontic management of mandibular first molars with confluent middle mesial canals. Several studies have been reported with aberrant canal morphology in mandibular first molar. [6,7,8] A good preoperative peri-apical radiograph taken from at least two different horizontal angles helps in accurate interpretation of the complete root canal system.[9] Clinically, the location of the canal orifices by a proper access cavity preparation, examination of the pulp chamber floor with a sharp explorer, troughing of grooves with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, and per-forming the sodium hypochlorite "champagne bubble" test, fibro-optic transillumination, visualizing canal bleeding points and the feeling of a "catch" on the canal wall during instrumentation are important aids. Advancements in ultrasonic activation systems have improved the detection, exploration and effective debridement of the additional canals. The radiographic findings suggestive of additional canals include the fast break phenomenon, eccentric location of the endodontic file during working length determination, inconsistent apex locator readings, and the tracing of a sinus tract laterally away from the main canal.[10] Dental loupes are one of the most common magnification systems used in dentistry. It provides better visualization as it enables the clinician to treat cases which are labeled as having poor prognosis or un-treatable. Magnification has been found to increase the detection of extra canals. In this paper, both cases were successfully managed endodontically using dental loupes.

4 | CONCLUSION

The middle mesial canal is an additional canal located between the usual mesiobuccal and mesiolingual canals in the mesial root of mandibular first molars. Even though its incidence is low, the importance of looking for this canal has a high clinical relevance. A modified endodontic access, the use of the operating microscope and periapical radiographs in two different horizontal projections are indicated to enhance the long-term favorable outcome of endodontic treatment. The management of additional root canals may be challenging but it is more imperative to accurately locate and successfully treat root canals to reduce failures. Even though the incidence of middle mesial canal is low, every effort made in looking for this canal has a high clinical relevance. A clinician should be vigilant and use additional aids for canal negotiation, whenever an additional or aberrant canal anatomy is suspected.

REFERENCES:

1. Baugh D, Wallace J. Middle mesial canal of the mandibular first molar: A case report and literature review. J Endod 2004;30:185-6.

2. Holtzmann L. Root canal treatment of a mandibular first molar with three mesial root canals. Int Endod J 1997;30:422-3.

3. Martinez-Berna A, Badanelli P. Mandibular first molar with six root canals. J Endod 1981;8:348-52.

4. Navarro LF, Luzi A, Garcia AA, Garcia AH. Third canal in the mesial root of permanent mandibular first molars: Review of

5. literature and presentation of 3 clinical reports and 2 in vitro studies. Med Oral Patol Oral Cir Bucal 2007;12:605-9.

6. Vertucci FJ, Williams RG. Root canal anatomy of the mandibular first molar. J N J Dent Assoc 1974;48:27-8.

7. Baugh D, Wallace J. Middle mesial canal of the mandibular first molar: A case report and literature review. J Endod 2004;30:185-6.

8. Holtzmann L. Root canal treatment of a mandibular first molar with three mesial root canals. Int Endod J 1997;30:422-3.

9. Weine FS. Three canals in the mesial root of mandibular first molar: Case report. J Endod 1981;8:517-20.

10. R. C. Burns and E. J. Herbranson, "Tooth morphology and access cavity preparation," in Pathways of the Pulp, S. Cohen and R. C. Burns, Eds., pp. 173–229, St. Louis, Mo, USA, Elsevier Mosby, 8th edition, 2002.

11. H. Fabra-Campos, "Unusual root anatomy of mandibular first molars," Journal of Endodontics, vol. 11, no. 12, pp. 568–572,1985.

REVIEW ARTICLES

Revolutionizing Oral Cancer Detection: Fusing The Power of Light and AI for Early Diagnosis

Darshana SN[1] | Anjani Sravya M[2] | Ramnarayan BK[3] | Mahesh DR[4] | Preeti Patil[5]

[1]Senior Lecturer, Department of Oral Medicine and Radiology, Dayananda Sagar College of Dental Sciences, Karnataka, India

[2]Under Graduate Student, Dayananda Sagar College of Dental Sciences, Karnataka, India

[3]Professor and Head of Department of Oral Medicine and Radiology, Dayananda Sagar College of Dental Sciences, Karnataka, India

[4]Reader, Department of Oral Medicine and Radiology, Dayananda Sagar College of Dental Sciences, Karnataka, India

[5]Reader, Department of Oral Medicine and Radiology, Dayananda Sagar College of Dental Sciences, Karnataka, India

Correspondence
Corresponding author: Darshana SN
Email: darshananayak@dscds.edu.in

Present address
Dayananda Sagar College of Dental Sciences, Shavige Malleshwara Hills, Kumaraswamy Layout, Bangalore 560 078, Karnataka, India

Abstract

Early detection and accurate diagnosis of oral cancer are critical for improving patient prognosis. However, current screening methods often fail to identify all lesions, highlighting the need for more effective approaches. Optical Coherence Tomography (OCT), an advanced optical imaging technology, shows promise in detecting malignant cells. OCT images require specialized interpretation due to their detailed information. Artificial Intelligence (AI), leveraging trained algorithms, can analyze imperceptible variations, overcoming barriers that have delayed OCT integration into oral cancer screening. This review explores OCT's depiction of precancerous and cancerous oral lesions and discusses AI's role in enhancing detection and diagnosis.

KEYWORDS

Oral Cancer, Early Diagnosis, Optical Coherence Tomography (OCT), Artificial Intelligence (AI), Cancer Detection

1 | INTRODUCTION

Globally, Oral Cancer ranks sixth in cancer incidence, presenting significant health challenges.[1] Oral squamous cell carcinoma (OSCC), the predominant type, emphasizes the critical importance of early detection for effective treatment and improved survival rates.[2,3] Optical Coherence Tomography (OCT) is an advanced, noninvasive imaging technique utilizing interferometry to produce high-resolution images.[4] Its rapid, three-dimensional imaging capabilities have made it increasingly valuable in various medical specialties, including oncology.[5] Artificial Intelligence (AI) has shown remarkable accuracy in biomedical imaging, aiding in personalized cancer treatment decisions.[3] The integration of AI into oral cancer research and clinical practice holds promise for improving patient outcomes.[6] AI, a field of computer science simulating human intelligence in machines, employs Machine Learning (ML) and Deep Learning (DL) techniques to analyze complex datasets and enhance diagnostic accuracy.[7]

2 | MECHANISM OF OCT

OCT uses light sources to penetrate tissues, interacting based on tissue properties such as absorption and reflection.[1] Unlike ultrasonography, OCT offers higher resolution and different receiving mechanisms, facilitating detailed imaging.[7] Interferometry is fundamental to OCT, involving the division of light into reference and sample beams to create interference patterns.[1] This principle enables OCT to capture intricate structural details from tissues, crucial for precise clinical imaging. By combining the imaging capabilities of OCT with the analytical power of AI, researchers aim to innovate oral cancer detection, potentially improving screening accuracy and patient outcomes. (Fig1)
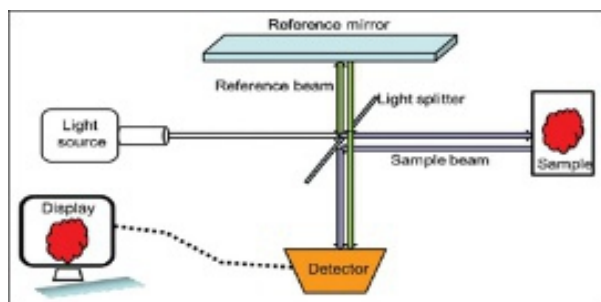
Fig:1   Basic Principle of OCT[1]

2.1 | TYPES OF OCT DEVICES

Optical Coherence Tomography (OCT) devices are classified based on their reference arm optics into time-domain and frequency-domain variants. Among frequency domain devices, two main types are spectral OCT (SD-OCT) and swept-source OCT (SS-OCT). SS-OCT employs an ultrahigh-speed laser beam with a wavelength in the kilohertz range and a center wavelength of 1300 nm. This configuration enhances system sensitivity, penetration depth, resolution, and scanning speed (achieving imaging in one second or less), thereby reducing acquisition time. The axial and transverse resolutions of SS-OCT are determined by the focal spot size and the width of the laser beam line, respectively [7]

Time-domain OCT (TD-OCT) involves measuring optical path lengths (OPLs) by moving a reference reflector, while spectral domain OCT (SD-OCT) or Fourier domain OCT (FD-OCT) calculates OPLs using various wavelengths without requiring a moving reflection mirror. An SD-OCT system shares similar components with TD-OCT but includes additional elements like a grating, sensor array (typically a CC-array), or spectrometer.[8]

Normal Mucosa in OCT: A study conducted by Albrecht, et al. in 2020 on healthy human oral mucosa in OCT image.[9]

1. Labial and Alveolar Mucosa: The epithelial surface of the alveolar mucosa was found to be intact in 92.2% and 95.4% of measurements, with a homogeneous layer observed in 96.6% and an average thickness of 142 ± 15 μm. [9]
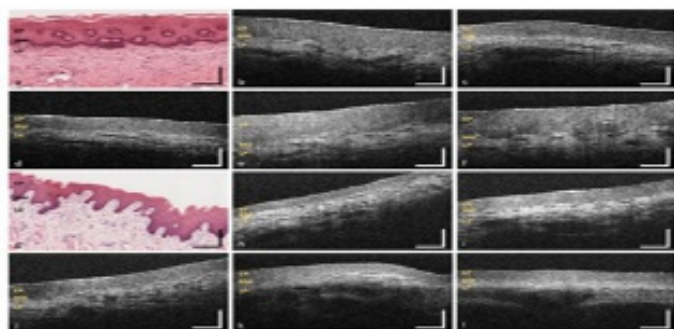
Fig:2

Optical coherence tomography (OCT) images show (b–f) the labial mucosa and (h–l) the alveolar mucosa. Representative images include the upper lip (MP1) (b, c), lower lip (MP3, MP4) (d–f), upper alveolar region (MP2) (h, i), and lower alveolar region (MP5) (j–l). Histological cross sections stained with hematoxylin and eosin (HE) depict the labial and alveolar mucosa (a, g) with modifications noted (EP: epithelium, BM: basement membrane, LP: lamina propria. Scale bars: 200 μm)."(Fig.2)

2.Buccal Mucosa: Analysis of OCT images of the buccal mucosa showed surface alterations in 30.6% of cross-sections, a homogeneous epithelium in 74.6%, and an intact basement membrane in 60.8%. Vascular supply appeared moderate in 67.7%, but additional features were not discernible due to the presence of fat tissue and limitations in imaging depth. [9]
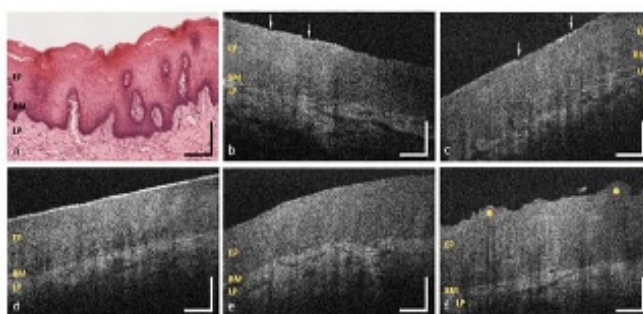

Fig: 3

CT images of the buccal mucosa are shown in (b–f). These images depict the (b, c) anterior (MP6), (d) central (MP7), and (e, f) posterior buccal regions (MP8). Histological cross sections stained with hematoxylin and eosin (HE) illustrate the buccal mucosa, highlighting key structures such as the epithelium (EP), basement membrane (BM), and lamina propria (LP). Arrows indicate areas of epithelial surface alteration, while yellow dots represent uneven surface profiles. Scale bars: 200μm(Fig.3)

3.Sublingual Mucosa: OCT images from the ventral tongue and mouth floor showed intact epithelial surfaces, homogeneous structures, and extensive vascular supply due to large sublingual arteries and veins. 86.6% of sections were highly vascularized. [9]
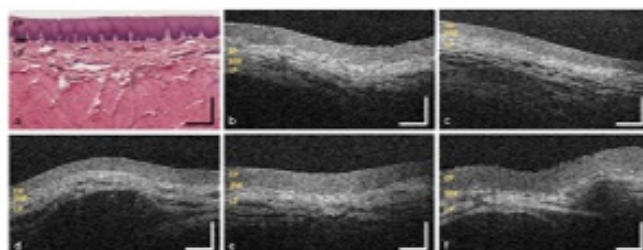

Fig: 4

OCT images of the ventral tongue (b,c) and the mouth floor (MP11) (d–f). The sample pictures represent the anterior (MP9) (b) and posterior sublingual region (MP10) (c). Exemplary HE stained histological cross sections depicting the sublingual mucosa (a). (EP: epithelium, BM: basement membrane, LP: lamina propria. Scale bars: 200 μm).(Fig.4)

4.Hard Palate: The hard palate shows various alterations in the epithelial surface, with convex ridges (38.8%) corresponding to transverse palatal folds. Approximately 37.5% of the epithelial layer exhibits inhomogeneity, reflecting adaptation to masticatory function. Female volunteers tend to exhibit lower values compared to males. The basement membrane appears indistinct, and minor salivary glands are observed in 15.0% of OCT cross-sections. [9]
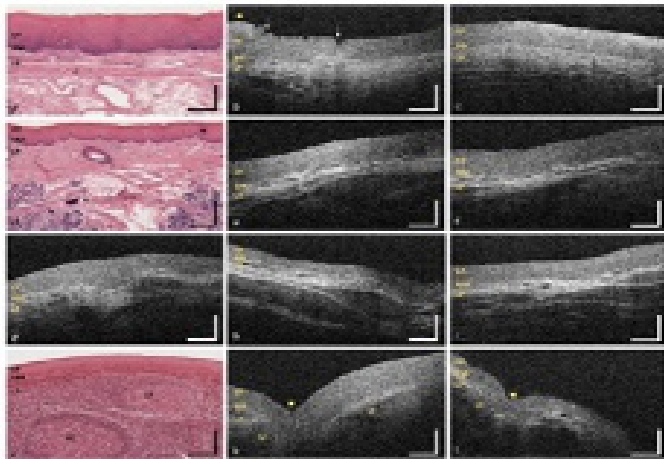

Fig:5

OCT images depict the (b, c) hard palate (MP12), (e, f) soft palate (MP13), (g) uvula (MP14), (h, i) oropharynx (MP15), and (k, l) palatine tonsil (MP16). Histological cross-sections stained with hematoxylin and eosin (HE) illustrate the (a) hard palate, (d) soft palate, and (j) palatine tonsil. Key features such as the epithelium (EP), basement membrane (BM), lamina propria (LP), and lymphoid follicle (LF) are identified. Arrows indicate areas of epithelial alteration, while yellow dots represent palatal ridges and tonsillar crypts. Scale bars: 200 μm.(fig.5)

5. Soft Palate and Oropharynx: The soft palate, uvula, and oropharynx were evaluated for the integrity of their epithelial surface, revealing a consistently homogeneous epithelium. Significant vascularization by major vessels was observed in the majority of cases (56.1%), accompanied by a well-defined vessel network within the lamina propria. Clusters of salivary glands were identified in 47.4% of cases, indicating effective moistening of the alveolar region. [9]
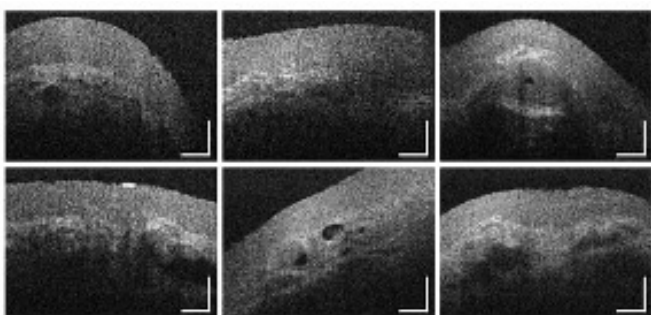

Fig:6

Additional intensity-based OCT cross-sections of the mucosal tissue were obtained for the soft palate (MP13) and the oropharynx (MP15). Scale bars: 200 μm (Fig.6)

6.Palatine Tonsils: OCT cross sections were used to analyze the palatine tonsil, revealing an intact epithelium in 70.6% of cases and an uneven surface profile in 87.5%. Age-related variations were noted, with reduced thickness observed in participants aged 25-45. The basement membrane appeared indistinct in 52.2% of cases, while moderate vascularization was evident in
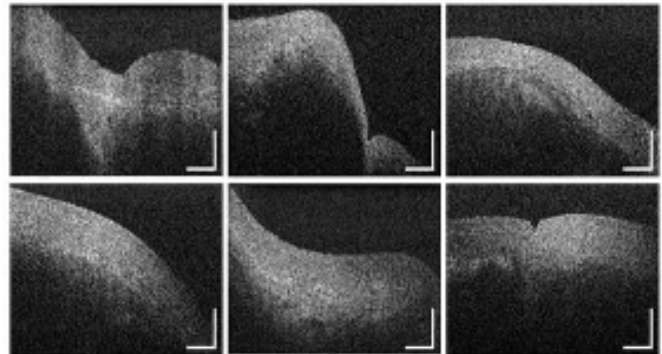

Fig: 7

Additional intensity-based OCT cross sections of the mucosal tissue from the palatine tonsil (MP16) were included. Scale bars: 200 μm.(Fig.7)

Cancer Indicators

Optical Coherence Tomography (OCT) images are capable of detecting neoplastic alterations in epithelial tissues characterized by abnormal cells with enlarged nuclei. Key histological indicators of malignancy include enlarged dysplastic cells, irregular stratification, basal hyperplasia, and elongated papilla cores. Dysplastic cells typically exhibit a scattered speckle pattern on OCT B-scans. Researchers have explored markers within the subepithelial tissue, basement membrane, and epithelial mucosa to differentiate between normal, premalignant, and cancerous tissues of the oral mucosa. Thickening of the basement membrane serves as an indication of tumor invasion, suggesting potential malignant changes. Both basement membrane integrity and epithelial thickness serve as reliable markers for distinguishing between invasive cancer and normal or dysplastic tissues. Dysplastic transformations may involve fibroblast proliferation, alterations in collagen and other extracellular components, and changes in the stromal environment. [7]

OCT images of Various lesions
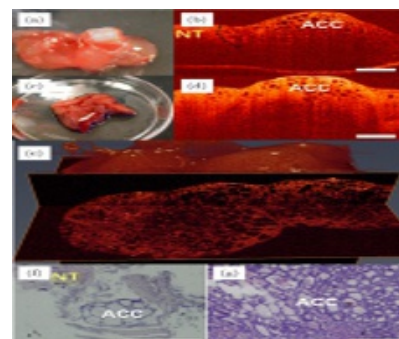1. Adenoid cystic Carcinoma:

Fig: 8

Images of adenoid cystic carcinoma are presented as follows: (a) and (c) depict photographs of the specimen, while (b) and (d) show 2D OCT images of adenoid cystic carcinoma in palate tissue from two different patients. Additionally, (e) displays a 3D OCT image of adenoid cystic carcinoma. Corresponding histopathological images are provided in (f) and (g). ACC refers to adenoid cystic carcinoma, and NT indicates normal tissue.(Fig.8)[10]
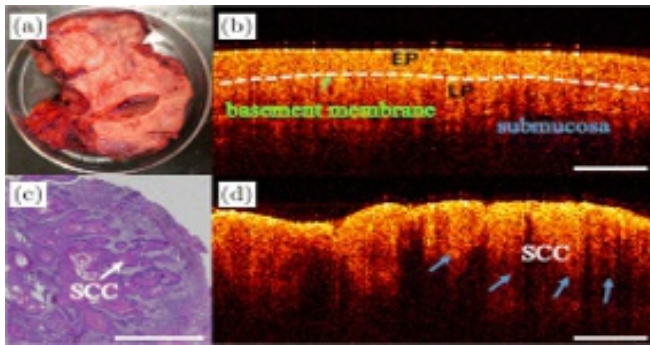
2. Squamous Cell Carcinoma:

Fig: 9

Furthermore, OCT images and corresponding histology of squamous cell carcinoma (SCC) are shown: (a) is a photo of the excised tissue specimen; (b) and (d) represent 2D OCT images from different positions of the same specimen, with (b) showing normal oral mucosa and (d) showing SCC. (c) presents the corresponding histopathological image of SCC. EP denotes the epithelial layer, and LP stands for lamina propria.(fig.9) [10]
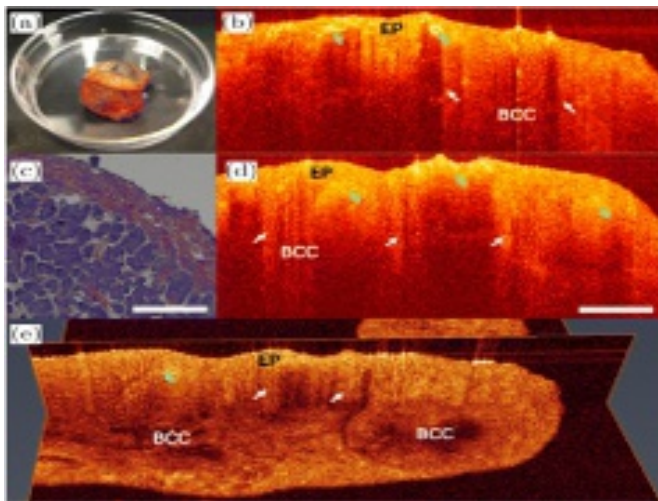
3. Basal-Cell Carcinoma:

Fig: 10

Images of basal cell carcinoma (BCC) are presented as follows: Panel (a) shows a photograph of the excised tissue specimen, while panels (b) and (d) display 2D OCT images of BCC from the same patient. Panel (c) presents the corresponding histopathological image, and panel (e) shows the 3D OCT image. EP refers to epithelial tissue.(Fig.10) [10]

4. Lipoma: Images of lipoma include panel (a) featuring a photograph of the excised tissue specimen. Panel (b) shows an OCT image of the lipoma, and panel (c) depicts its corresponding histopathological image. FT denotes fibrous tissue, and FV represents fat vesicle.
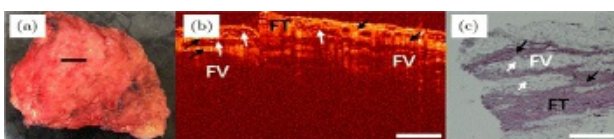

Fig: 11

Images of lipoma include panel (a) featuring a photograph of the excised tissue specimen. Panel (b) shows an OCT image of the lipoma, and panel (c) depicts its corresponding histopathological image. FT denotes fibrous tissue, and FV represents fat vesicle.(Fig.11) [10]
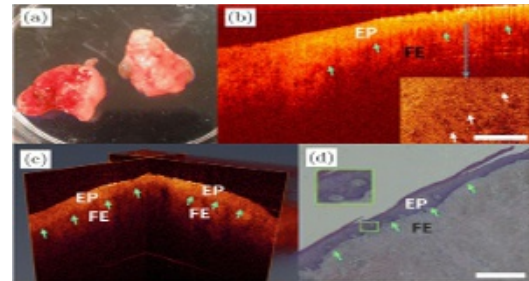
5. Fibrous Epulis:

Fig: 12

For images of fibrous epulis, panel (a) shows a photograph of the excised tissue specimen. Panel (b) displays a 2D OCT image and an en-face OCT image derived from the dashed line of the fibrous epulis. Panel (c) illustrates the 3D OCT image of fibrous epulis, and panel (d) presents its histological image. EP denotes epithelial tissue, and FE stands for fibrous epulis.(Fig.12) [10]
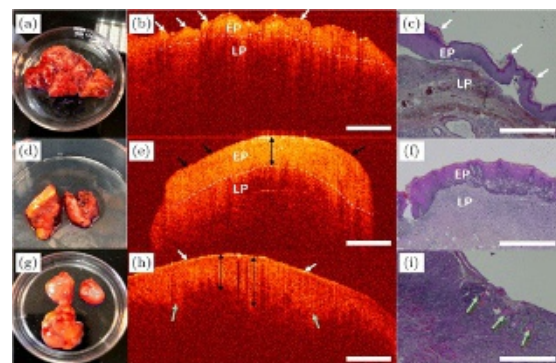
6.Leukoplakia:

Fig: 13

OCT images and their corresponding histopathological images of leukoplakia are presented as follows: Images (a) and (d) depict photographs of tissue samples, while Images (b) and (e) show 2D OCT images of leukoplakia from two different patients. Image (g) is a photograph and (h) is a 2D OCT image showing leukoplakia with signs of canceration. Histopathological images corresponding to (a), (d), and (g) are shown in (c), (f), and (i), respectively. EP denotes the epithelial layer, and LP stands for lamina propria(Fig.13) [10]

7. Normal mucosa, Oral squamous cell carcinoma:

Morphological characteristics and statistical analysis of oral tissues are illustrated as follows: Panel (a) displays an OCT image of normal mucosa, while panels (b) and (c) show OCT images of leukoplakia with epithelial hyperplasia (LEH) and oral squamous cell carcinoma (OSCC), respectively. Corresponding histopathological images are shown in panels (d) to (f). The region of interest is indicated as 256×256 pixels.(Fig.14) [10]
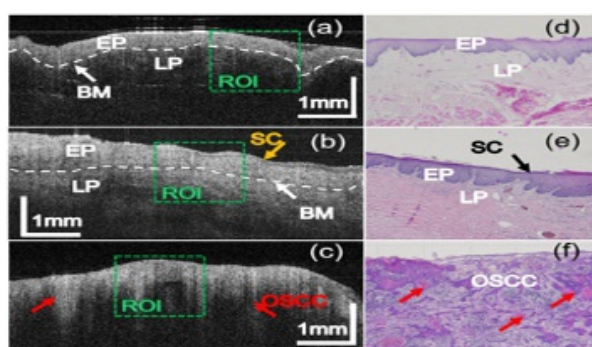
Fig: 14

Integration of AI and OCT

The use of OCT in oncology faces limitations such as restricted penetration depth, scan volume, high resolution, noise, and challenges in image interpretation, which is often operator-

Stages in Integrating OCT with AI:

1. Data collection
2. Image processing
3. Development of AI models
4. Validation of AI Models [11]

Artificial Neural Networks (ANNs) are machine learning algorithms consisting of layers of neurons, with convolutional neural networks (CNNs) being widely used for visual data analysis. These networks are trained using structured data to continuously enhance their performance.

Research employing various AI algorithms for interpreting OCT images is detailed below

1.Pande P, Shrestha S, Park J, et al. [12] (2014): The objective of this study is to assess the feasibility of using image analysis algorithms for automated characterization and classification of OCT images in a hamster cheek pouch tumour model. Additionally, the study aims to evaluate the potential of OCT-based automated diagnosis of oral cancer.

Two algorithms were used:

Algorithm 1- Algorithm for filtering A-lines in a B-scan

Algorithm 2- Algorithm for generating a binary mask corresponding to the epithelial region in a nonlayered B-scan.

The study presents a segmentation algorithm for identifying epithelial regions in OCT B-scans, achieving 80.6% sensitivity and classification accuracy, using random forest for robustness against noisy labels and overfitting.

2.Hwang DK et al.[11] (2020): OCT macula cross-section scanning images from patients with diabetic macular edema (DME) to classify the disease.

AI models were developed using GGG16 and InceptionV3, with transfer learning applied. The accuracy, sensitivity, and specificity of the models were 92.82%, 93.09%, 96.48%, 95.15%, and 89.63%, respectively.

3.James et al.[13] (2021): The aim of this study is to develop a decision tree using an OCT diagnostic system to accurately identify and differentiate between cancer/dysplastic lesions and non-dysplastic lesions in oral cancer screening. A MATLAB based simple algorithm-score and an Artificial Neural Network-Support Vector Machine (ANN-SVM) based model was used.

The study uses a retrained convolutional neural network to classify three-dimensional OCT images of head and neck mucosa, identifying normal and abnormal tissues with 100% sensitivity and 70% specificity. The algorithm predicts the severity of oral squamous cell carcinoma (OSCC) lesions based on 172 oral sub-sites. The scores for dysplastic lesions differ significantly, with sensitivity of 93% and specificity of 74%.

4. Wei Yuan et.l[14] (2022): The aim of this study was to develop the automatic non-invasive OSCC diagnosis approach to identify the malignant tissues on Optical Coherence Tomography (OCT) images.

This study used Multi-Level Deep Residual Learning (MDRL) network. The MDRL system attains the outstanding diagnostic performance, with 91.2% sensitivity, 83.6% specificity, 87.5% accuracy, 85.3% PPV, and 90.2% NPV in image-level, with 0.92 AU value. Besides, it also implements 100% sensitivity, 86.7% specificity, 93.1% accuracy, 87.5% PPV, and 100% NPV in the resected patch-level.

5. Yang et al.[10] 2020:To assess deep-learning-based algorithms for OCT images to assist clinicians in oral cancer screening and diagnosis

Three CNNs (convolutional neural networks), including LeNet-5, VGG16, and ResNet18, and Machine learning. CNNs outperform machine-learning in detecting and diagnosing oral cancer, with accuracy of 92.52% and classification accuracy of up to 96.76%, demonstrating their logic and interpretability in OCT images.

OCT images of Oral lesions interpreted by AI:
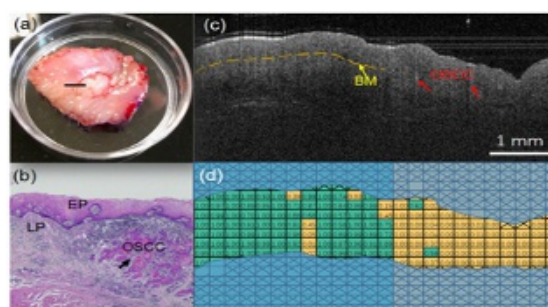
1. Oral Squamous Cell Carcinoma

Fig: 15: a) displays an image of the excised tissue specimen. (b) presents a histopathological image where the normal region is on the left and the cancerous region is on the right. (c) shows the OCT image corresponding to (a). (d) depicts the prediction visualization of oral squamous cell carcinoma (OSCC).[2]

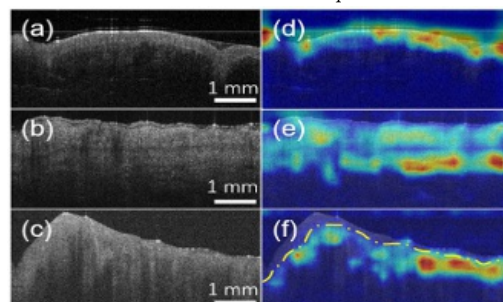2. Normal mucosa, Oral squamous cell carcinoma

Fig: 16: Grad-CAM visualization on OCT images of oral tissues is described as follows: (a–c) depict OCT images of normal mucosa, epithelial hyperplasia (LEH), and oral squamous cell carcinoma (OSCC), respectively. (d–f) show the corresponding activation maps highlighting distinct feature aggregations. [2]

Advantages of Integrating OCT and AI

1. Early Detection: AI can detect subtle changes in OCT scans that may be overlooked by human observers, enabling early identification of diseases or abnormalities.

2. Improved Accuracy: AI algorithms can analyse OCT images with exceptional precision and accuracy.

3. Speed and Efficiency: AI processes OCT images much faster than humans, leading to quicker diagnosis and treatment decisions.

4. Quantitative Analysis: AI enables quantitative analyses of OCT data, providing precise measurements crucial for monitoring disease progression, treatment efficacy, and research purposes.

5. Accessibility: AI's widespread adoption can extend advanced diagnostic capabilities to regions with limited access to specialized healthcare professionals.

6. Enhanced Research Capabilities: Combining OCT and AI accelerates medical research by providing large datasets for studying diseases, drug responses, and treatment outcomes, potentially leading to significant breakthroughs. [2, 7, 11]

Limitations of Integrating OCT and AI

Challenges include the potential deskilling of physicians due to increased reliance on automation, AI's limitation in holistic clinical decision-making, the necessity for robust datasets to train AI models, and difficulties in accommodating the inherent ambiguity and variability of clinical medicine. Overcoming these obstacles requires standardizing data labeling, validating automated interpretations, and developing supportive infrastructures. Furthermore, supplying OCT imaging data for AI algorithms necessitates additional research. [2, 7]

3 | CONCLUSION

AI demonstrates promising diagnostic performance with high sensitivity in oral cancer detection. Continued advancements in image acquisition technology and AI algorithms are expected to further enhance diagnostic accuracy. AI algorithms have shown encouraging results in interpreting OCT images of oral mucosa, distinguishing between normal epithelium and precancerous or cancerous lesions. While integrating OCT and AI into clinical practice may take time, ongoing developments in AI for OCT image interpretation pave the way towards automated oral cancer screening using OCT.

CONFLICT OF INTEREST

The Authors declare no conflict of interest.

References:

1. Reddy RS, Sai Praveen KN. Optical coherence tomography in oral cancer: A transpiring domain. J Cancer Res Ther. 2017;13(6):883–8.

2. Yang Z, Pan H, Shang J, Zhang J, Liang Y. Deep-learning-based automated identification and visualization of oral cancer in optical coherence tomography images. Biomedicines. 2023;11(3).

3. Xu M, Chen Z, Zheng J, Zhao Q, Yuan Z. Artificial intelligence-aided optical imaging for cancer theranostics. Semin Cancer Biol.2023;94:62–80.

4. PODOLEANU A.G. Optical coherence tomography. Journal of Microscopy.2012; 247(3): 209-219

5. Tsai M-T, Lee H-C, Lee C-K, Yu C-H, Chen H-M, Chiang C-P, et al. Effective indicators for diagnosis of oral cancer using optical coherence tomography. Opt Express. 2008;16(20):15847–62.

6. Lee DK. Application of artificial intelligence in oral cavity cancer: A review. J Clin Otolaryngol Head Neck Surg . 2023;34(2):23–6.

7. Ramezani K, Tofangchiha M. Oral cancer screening by artificial intelligence-oriented interpretation of optical coherence tomography images. Radiol Res Pract. 2022;2022:1614838.

8. Hsieh Y-S, Ho Y-C, Lee S-Y, Chuang C-C, Tsai J-C, Lin K-F, et al. Dental optical coherence tomography. Sensors . 2013;13(7):8928–49.

9. Albrecht M, Schnabel C, Mueller J, Golde J, Koch E, Walther J. In vivo endoscopic optical coherence tomography of the healthy human oral mucosa: Qualitative and quantitative image analysis. Diagnostics. 2020;10(10):827

10. Yang Z ,Shang J, Liu C and Zhang J, Hou F ,Liang Y. Intraoperative imaging of oral-maxillofacial lesions using optical coherence tomography Journal of Innovative Optical Health Sciences.2020;13(02)

11. Hwang D-K, Chou Y-B, Lin T-C, Yang H-Y, Kao Z-K, Kao C-L, et al. Optical coherence tomography–based diabetic macula edema screening with artificial intelligence. J Chin Med Assoc . 2020;83(11):1034–8.

12. Pande P, Shrestha S, Park J, Serafino MJ, Gimenez-Conti I, Brandon J, et al. Automated classification of optical coherence tomography images for the diagnosis of oral malignancy in the hamster cheek pouch. J Biomed Opt.2014;19(8).

13. James BL, Sunny SP, Heidari AE, Ramanjinappa RD, Lam T, Tran AV, et al. Validation of a point-of-care optical coherence tomography device with machine learning algorithm for detection of oral potentially malignant and malignant lesions. Cancers.2021;13(14):3583

14. Yuan W, Yang J, Yin B, Fan X, Yang J, Sun H et al. Noninvasive Diagnosis of Oral Squamous Cell Carcinoma by Multilevel Deep Residual Learning on Optical Coherence Tomography Images. Oral diseases 2022;29(1)

Graphene - A Multifaceted Panacea

Sarandha D L[1] | Smitha Sharan[2] | Sreeharsha TV[3] | Brunda K[4] | Pradeep Chandra K[5] | Harshitha Alva[6] | Monika N[7]

[1]Professor and Head of Department, Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

[2,3,4,6]Reader, Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

[5]Senior Lecturer, Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

[7]Post Graduate Student, Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Bangalore,Karnataka,India

Abstract

Graphene-based materials have high mechanical, physiochemical, antibacterial, and stem cell differentiating properties and thus been shown to have advantageous properties in biomedical and dental applications due to their versatility. Although graphene-based materials have displayed great advantages in augmenting the functioning of many dental materials, little research has been per-formed to specifically test the biocompatibility of graphene for dental applications. As compared to the body, the oral environment varies greatly and must be considered when evaluating biocompatibility requirements for dental applications. This review will discuss in-vitro and in-vivo studies that assess graphene's cytotoxicity, antibacterial properties, and the various applications of graphene in the field of dentistry to evaluate the overall biocompatibility and use of graphene-based materials for dental applications.

KEYWORDS

Graphene Oxide, Anti-bacterial property, Bioactivity, Tissue Engineering, Implant coating

Correspondence

Corresponding author Pradeepchandra K
Email: pradeepchandrak@dscds.edu.in

Present address

Department of Prosthodontics, Crown and Bridge, Dayananda Sagar College of Dental Sciences, Shavige Malleswara Hills, Kumaraswamy Layout, Bangalore 560 078, Karnataka; India.

1 | INTRODUCTION

Advances in technology have greatly influenced the field of dentistry in recent times. The advent of nanotechnology is one such advance that has helped improve the properties of dental materials when in-corporated into them. Since dental materials are placed within the oral cavity and are constantly in contact with saliva and water, exposed to temperature changes, masticatory forces and acidic substances con-sumed by the patient, wearing away of the material has always been a concern. There has thus, always been an interest in developing den-tal materials with improved lifespan in the oral cavity. Nanotechnology has helped greatly in moving towards achieving this. Various nano-materials have been incorporated into dental materials to enhance their properties. Graphene is one such nanomaterial and its derivatives have attracted great attention, owing to their excellent physicochemical

property, morphology, biocompatibility, multi-differentiation activity, and antimicrobial activity.[1] It is a carbon-based nanomaterial consisting of two-dimensional sheets that are made up of sp2 hybridized carbon atoms bonded together in hexagonal structures.[2]

2 | BACKGROUND

Graphene was first isolated in **2004** by Novoselov et al.[3], and it con-sists of two-dimensional sheets that are made up of sp2 hybridized carbon atoms bonded together in hexagonal structures. It has unique structural, chemical and thermal properties which has led to its utili-sation in various fields like biomedical, electronics, energy production, bimolecular sensors etc. Graphene nanomaterial is available as ultrathin graphite, few layer graphene, graphene oxide [Go], reduced graphene oxide[rGo] and graphene nanosheets.4 Graphene derivatives are widely

applied in the dental fields of restorative materials, adhesives, cements, primers and many more because of properties such as biocompatibility, anti-microbial efficiency and excellent physico-mechanical properties. Pristine graphene - that is graphene in its original, pure, unoxidized form - enjoys superior properties to its oxidized counterpart, but pris-tine graphene isn't easy to come by and its lack of abundance has held back the development of graphene-based functional devices.[5] As per literature, there are more than 2,942 studies related to graphene-based materials for dental applications.1 This emerging research in regard to graphene seems promising and hence has prompted this review of liter-ature with an intent towards evidence based application of graphene in dentistry.

3 | METHOD OF COLLECTING DATA

Review is facilitated by literature search through online and offline modes, that provided us with 26 relevant publications in regard to graphene and its applications.

4 | PROPERTIES OF GRAPHENE

4.1 | BIOCOMPATABILITY

When used in dental materials, graphene is in constant contact with the oral tissues and saliva. It is thus essential for the material to be bio-compatible. Researchers have studied its biocompatibility in various studies. They have found various factors to be involved in determining its biocompatibility. Up to date, the affected factors involved concen-trations, surface functionalization, and so on. Some researchers showed that the toxicity of Graphene oxide to fibroblast cells was minimal when the concentration of Graphene oxide was lower than 20 µg/ml. whereas, the cytotoxicity of graphene oxide increased when the concen-tration was up to 50 µg/ml.[6] Wang et al. investigated the cytotoxicity of graphene oxide in mice and the results demonstrated a dose-dependent toxic behaviour in vivo. The cytotoxicity of graphene oxide increased when the concentration was increased.[7] When the concentrations of Graphene Oxide were 0.1 and 0.2 mg, there was no toxicity de-tected. With the increase concentration to 0.4 mg, chronic toxicity was observed in mice.7 Diana et al. investigated the cytotoxicity of GO, nitrogen-doped graphene (N-Gr), and thermally reduced Graphene Ox-ide (TRGO) on human dental follicle stem cells and analysed the involved specific mechanism. The result showed the lowest cytotoxicity of GO and the highest cytotoxicity of TRGO.[8]

4.2 | ANTI-BACTERIAL PROPERTY

The anti-bacterial property of graphene has gained interest as it can lead to help achieve infection control when added into dental mate-rials. The antibacterial effect of graphene-based materials was first discovered by Huet al.[9] A complete understanding of the anti-bacterial property of graphene is yet to be completely understood. Many re-searchers have proposed different theories. Physical damage is induced by blade like graphene materials piercing through the microbial cellu-lar membrane causing leakage of intracellular substance leading to cell death.[10] Wrapping and photo thermal ablation mechanism could also provoke bacterial cell damage by enclosing the bacterial cells, providing an unique flexible barrier to isolate bacteria growth medium, inhibit-ing bacteria proliferation, and decreasing microbial metabolic activity and cell viability.2 Chemical effect is primary oxidative stress mediated with production of ROS [reactive oxygen species] as excessive intracel-lular ROS accumulation could cause intracellular protein inactivation, lipid peroxidation, and dysfunction of the mitochondria, which lead to gradual disintegration of cell membrane and eventual cell death.[11]

4.3 | APPLICATIONS IN DENTISTRY

4.3.1 | Graphene added to PMMA

Polymethyl methacrylate resin has been used in dentistry from many decades for fabricating denture bases due to advantages, such as easy manufacturing process, low cost, low modulus of elasticity, easy repair, and good aesthetics. However, the limitations of PMMA [polymethyl methacrylate] such as low mechanical properties, large polymerization shrinkage, and the poor inhibition of biofilm formation reduce the life-span of the material.[12] In recent studies, researchers have tried the addition of graphene oxide into polymethyl methacrylate for improv-ing the mechanical and antibacterial properties of PMMA. Because of the mechanical effect of graphene on PMMA, Azevedo et al. has achieved the definitive maxillary full-arch rehabilitation by incorpo-rating Graphene oxide into the PMMA resin. Review after 8 months revealed satisfactory mechanical and aesthetic outcome, indicating that the addition of GO [graphene oxide] to PMMA resin would be a good choice for prosthetic rehabilitation.[13] Bacali et al. reported on PMMA with graphene-silver nanoparticles (Gr-Ag), and the mechanical proper-ties, hydrophilic abilities, and the morphology of the composites were further evaluated. The results showed that the compression parame-ters, bending, and tensile strength of the Gr-Ag fillers were significantly higher than the pure PMMA group, indicating that the addition of Gr-Ag improved the mechanical properties of PMMA resin. Moreover, Bacali and his co-workers also assessed the antibacterial properties of Gr-Ag–modified PMMA, and the results confirmed that Gr-Ag–modified groups showed higher inhibition effect in all Gram-negative strain, Staphylococcus aureus, E. coli, and Streptococcus mutans.[14]

4.3.2 | Use of graphene in restorative dentistry

It is always desirable for restorative materials to have a prolonged life in the oral cavity. The added advantage of anti-bacterial property of graphene can help in infection control. Graphene when added to GIC has shown to cause a significant improvement in its mechani-cal and biologic properties. Fluoride graphene [FG] when prepared by hydrothermal reaction of graphene oxide and mechanically blend

with glass ionomer could produce a GICs/FG composites matrix, which could significantly enhance the mechanical, tribological, and antibacterial properties of glass ionomer.[15] Graphene has been used in various types of dental resins to strengthen bonding and adhesive strength in restorative dentistry. However, if the site it not properly sealed, bac-teria can easily access the cured dental tissues through cavities at the tooth restoration interface.2 In addition, adhering materials onto dentin is challenging since dentin has higher water content compared to enamel and is less mineralized. Graphene nanoplatelets have been studied for antimicrobial and antibiofilm properties and combined with polymer materials to act as better dental adhesive. From the study, the graphene nanoplates inhibited the growth of S. mutans bacteria in vitro and demonstrated good mechanical performance without decreasing adhesive strength.[16]

4.3.3 | Application of graphene in implants

Titanium implants have in recent times become a popular choice of prosthesis to replace missing teeth. Titanium has been shown to have good osseointegration property. At the hard tissue interface, osteogenic properties of implant material are essential for osseointegration while at the soft tissue interface, to ensure a tight epithelial seal preventing bacterial invasion is obligatory. Failure of implants can happen due to poor osseointegration and peri-implantitis of titanium and its alloys.[17] Therefore, many surface modifications by graphene-based materials have been used to improve the bioactivities of titanium and its al-loys.[18] Gu et al. successfully constructed single-layer graphene sheets on the titanium substrates by PMMA-mediated method.[19] The studies conducted showed that graphene sheets exhibited superior adhesion and proliferation properties of human gingival fibroblasts (hGFs), hu-man adipose-derived stem cells (hASCs), and human BMMSCs (Bone Marrow Mesenchymal Stem Cells) compared with the control.[20] When graphene is coated on titanium substrate, the hydrophobic character of graphene film exerted self-cleaning effect on its surfaces decreasing the adhesion of microorganism including S. sanguinis and S. mutans.[21] Ad-ditionally, compared to titanium alone, graphene possesses osteogenic property enhancing the expression of osteogenic related genes RUNX2 [Runt-Related Transcription Factor 2, COL-I [CONSTANS-like 1], and ALP [aluerin like protease], boosting osteocalcin gene and protein ex-pression, and consequently increasing the deposition of mineralized matrix.2

4.3.4 | Tissue Engineering

Tissue engineering is being widely used in repairing and regenerating the defects caused by tumours, traumas, infections etc. Scaffolds pro-vide a platform for the attachment, proliferation, and differentiation of different stem cells in the tissue engineering. Many researchers proved that graphene-based materials were suitable for fabricating or coating for scaffolds in the tissue engineering. A pioneering study demonstrated that graphene and Graphene Oxide can accelerate MSC [mesenchy-mal stem cell] osteogenic differentiation to different degrees due to π–π stacking, hydrogen bonding, and electrostatic interactions with pro-teins, which may be the underlying mechanism supporting the coating application.22

4.3.5 | Teeth whitening

Hydrogen peroxide is a commonly used material for in-office teeth whitening procedures. Though it has proven to be an effective bleach-ing agent, use of excessive amounts of hydrogen peroxide is associated with side effects such as teeth sensitivity and gingival irritation. Su et al have therefore resorted to combining graphene oxide with hydrogen peroxide to improve the efficiency of the process and reduce the po-tential side effects.23 The CoTPP [Cobalt-TetraPhenylPorPhyrin]- rGO [reduced Graphene Oxide] nanocomposite can be used as a catalyst to produce more reactions between the staining molecules and H2O2, which accelerate the bleaching process.[23] In summary, graphene-based materials are a promising catalyst for tooth whitening application with proper types and concentrations.

4.3.6 | Drug Delivery

Localised drug delivery systems have garnered the interest of many practitioners as they provide the opportunity to deliver the desired quantity of drug to the site of interest. They also allow the controlled re-lease of the drug. This has led few researchers to look into graphene as an avenue to function as a drug delivery system. Graphene Nanosheet structure with high surface area and good water dispersibility is a promising candidate for drug carriers toward specific organs.[24] La et al. reported that GO is an efficient carrier for the delivery of therapeutic proteins.25 They applied GO-Ti [graphene oxide-titanium] implants as carriers to deliver BMP-2 [bone morphogenetic protein 2] for bone re-generation and successfully demonstrated that ionized GO can deliver proteins by binding through electrostatic interactions. Furthermore, they used a GO-Ti substrate for BMP-2 delivery as an osteoinductive and SP as a stem cell recruitment agent for in situ bone regeneration and reported that GO has the potential to sustain the release of BMP-2.[25] Trusek et al. found that GO had the potential in acting as a drug carrier especially in the therapy of dental inflammation.[26]

5 | CONCLUSION

Graphene-based nanoparticles are considered a topic of great interest in the field of dentistry. They have shown to be of great benefit in improving upon the performance of various dental materials. Addition-ally, graphene nanoparticles have been found to have adequate initial biocompatibility in the mouth when it comes to bone and tissue engi-neering. Addition of graphene has been considered in case of dental cements, adhesives, resins and as bio coatings to implants. Although graphene has been shown to display relatively good biocompatible qual-ities in various dental applications from in vitro tests, there is still a lack of long-term cytotoxicity studies of graphene nanoparticles in the body, as well as a lack of understanding as to how easily they can be excreted from the body. Various factors such as particle size and concentration have shown to influence the cytotoxicity of graphene. There is thus a need for standardization of biocompatibility requirements for dental ap-plications is also needed with long-term in vitro and in vivo studies to see the long term health effects.

CONFLICT OF INTEREST
There is no conflict of Interest

REFERENCES

1. Li X, Liang X, Wang Y, Wang D, Teng M, Xu H, Zhao B, Han L. Graphene-Based Nanomaterials for Dental Applications: Principles, Current Advances, and Future Outlook. Front Bioeng Biotechnology, 2022 ,

2. K. M. Regish, Deeksha Sharma, and D. R. Prithviraj, Techniques of Fabrication of Provisional Restoration: An Overview, Hindawi Publishing Corporation International Journal of Dentistry Volume 2011.

3. K. S. Novoselov, A. K. Geim, S. V. Morozov et al., "Electric field effect in atomically thin carbon films," Science, 2004.

4. Bei H., Yang Y., Zhang Q., Tian Y., Luo X., Yang M., et al. Graphene-Based Nanocomposites for NeuralTissueEngineering. Molecules 24 (4), 2019.

5. Wencheng Du, Hongbo Geng, Yang Yang, Yufei Zhang, Xianhong Rui, Cheng Chao Li, Pristine graphene for advanced electrochemical energy applications,Journal of Power Sources, 2019.

6. Wang K., Ruan J., Song H., Zhang J., Wo Y., Guo S., et al. Biocompatibility of Graphene Oxide. Nanoscale Res. Lett. 2011.

7. Wang G., Qian F., Saltikov C. W., Jiao Y., Li Y. Microbial Reduction of Graphene Oxide by Shewanella. Nano Res,2011.

8. Olteanu D., Filip A., Socaci C., Biris A. R., Filip X., Coros M., et al. (2015). Cytotoxicity Assessment of Graphene-Based Nanomaterials on Human Dental Follicle Stem Cells. Colloids Surf. B: Biointerfaces,2015.

9. Hu W., Peng C., Luo W., Lv M., Li X., Li D., et al. Graphene-based Antibacterial Paper. ACS Nano ,2010.

10. O. Akhavan and E. Ghaderi, "Toxicity of graphene and graphene oxide nanowalls against bacteria," ACS Nano, 2010.

11. T. Dutta, R. Sarkar, B. Pakhira et al., "ROS generation by reduced graphene oxide (rGO) induced by visible light showing antibacterial activity: comparison with graphene oxide (GO)," RSC Advances, 2015.

12. El Bahra S., Ludwig K., Samran A., Freitag-Wolf S., Kern M. (2013). Linear and Volumetric Dimensional Changes of Injection-Molded PMMA Denture Base Resins. Dental Mater,2013

13. Azevedo L., Antonaya-Martin J., Molinero-Mourelle P., del Rio-Highsmith J, Improving PMMA Resin Using Graphene Oxide for a Definitive Prosthodontic Rehabilitation - a Clinical Report. J. Clin. Exp. Dent ,2019.

14. Bacali C., Baldea I., Moldovan M., Carpa R., Olteanu D. E., Filip G. A., et al. Flexural Strength, Biocompatibility, and Antimicrobial Activity of a Polymethyl Methacrylate Denture Resin Enhanced with Graphene and Silver Nanoparticles. Clin. Oral Invest,2020.

15. R. S. Al-Hamdan, B. Almutairi, H. F. Kattan, S. Alresayes, T. Abduljabbar, and F. Vohra, "Assessment of hydroxyapatite nanospheres incorporated dentin adhesive. A SEM/EDX, micro-Raman, microtensile and micro-indentation study," Coatings, 2020.

16. Z. Akram, S. Aati, P. Clode, M. Saunders, H. Ngo, and A. S. Fawzy, "Formulation of nano-graphene doped with nano silver modified dentin bonding agents with enhanced interfacial stability and antibiofilm properties," Dental Materials, 2022.

17. Berglundh T., Jepsen S., Stadlinger B., Terheyden H. Peri-implantitis and its Prevention. Clin. Oral Impl Res. 2019

18. Barfeie A., Wilson J., Rees J. Implant Surface Characteristics and Their Effect on Osseointegration. Br. Dent J. 2015

19. Ming G., Lv L., Feng D., Niu T., Tong C., Xia D., et al. Effects of thermal Treatment on the Adhesion Strength and Osteoinductive Activity of Single-Layer Graphene Sheets on Titanium Substrates. Sci. Rep.2018

20. Gu, M.; Lv, L.; Du, F.; Niu, T.; Chen, T.; Xia, D.; Wang, S.; Zhao, X.; Liu, J.; Liu, Y.; et al. Effects of thermal treatment on the adhesion strength and osteoinductive activity of single-layer graphene sheets on titanium substrates. Sci. Rep. 2018

21. Qian W., Qiu J., Su J., Liu X. (2018). Minocycline Hydrochloride Loaded on Titanium by Graphene Oxide: An Excellent Antibacterial Platform with the Synergistic Effect of Contact-Killing and Release-Killing. Biomater. Sci.

22. O. Akhavan, E. Ghaderi, and A. Akhavan, "Size-dependent genotoxicity of graphene nanoplatelets in human stem cells," Biomaterials, vol. 33, no. 32, pp. 8017–8025, 2012.

23. I-Hsuan, Yu-Pin, Lee, Chen-Fu, Wang, Lai-Hao . Evaluating a Cobalt-Tetraphenylporphyrin Complex, Functionalized with a Reduced Graphene Oxide Nanocomposite, for Improved Tooth Whitening. J. Esthet Restor Dent.2016

24. Nan A. Miscellaneous Drugs, Materials, Medical Devices and Techniques. Side Effects Drugs Annu.2016

25. Hoseini-Ghahfarokhi M, Mirkiani S, Mozaffari N, Abdolahi Sadatlu MA, Ghasemi A, Abbaspour S, Akbarian M, Farjadian F, Karimi M. Applications of Graphene and Graphene Oxide in Smart Drug/Gene Delivery: Is the World Still Flat. Int J Nanomedicine. 2020.

26. Trusek A., Kijak E. (2021). Drug Carriers Based on Graphene Oxide and Hydrogel: Opportunities and Challenges in Infection Control Tested by Amoxicillin Release. Materials, 2021.

Myths surrounding Oral Cancer

Vidya MA[1] | Krishnanand PS[2]

[1]Reader, Department of Oral Pathology,
Dayananda Sagar College of Dental Sciences,
Bengaluru, Karnataka., India

[2]Professor and Head of Department,
Department of Oral Pathology, Dayananda
Sagar College of Dental Sciences, Bengaluru,
Karnataka., India

Correspondence

Corresponding author Vidya MA
Email: vidyama@dscds.edu.in

Present address

Department of Oral Pathology, Dayananda
Sagar College of Dental Sciences, Shavige
Malleshwara Hills, Kumaraswamy Layout,
Bangalore 560 111; Karnataka; India.

Abstract

Oral cancer poses a significant health challenge in India, which harbors the largest burden globally. With an alarming rise in cases predicted by GLOBOCAN, effective management is hindered by prevalent myths and misconceptions. This article explores common myths surrounding oral cancer, such as its association solely with smoking or age, and dispels these misconceptions through evidence-based insights. It emphasizes the importance of early detection and challenges the notion that oral cancer is easily identifiable, stressing the need for regular screenings. By debunking myths through education and awareness, this paper advocates for proactive measures to improve oral cancer outcomes in India and beyond.

KEYWORDS

Oral Neoplasms, Health Knowledge, Attitudes, Practice, Early Detection of Cancer Health Education

1 | INTRODUCTION

India has the largest number of oral cancer cases and one-third of the total burden of oral cancer globally. Oral cancer poses a serious health challenge to the nations like India which are undergoing economic transition.[1] GLOBOCAN predicted that cancer cases in India would increase to 2.08 million, accounting for a rise of 57.5 per cent in 2040 from 2020.[2] The increasing number of cases of oral cancer are the most important concern for community health as it is one of the common types of cancers in India.[3] As compared to the west, the concern of oral cancer is significantly higher in India as about 70% of the cases are reported in advanced stages (American Joint Committee on Cancer, Stage III-IV) because of detection in the late phase, the chances of cure are very low, almost negative; leaving five-year survival rates around 20%.[4] Many cancers are curable, provided they are detected early by screening and treated effectively. Cancer myths and misconceptions are potential barriers to early cancer diagnosis and treatment compliance. The social, emotional, and financial devastation that all too often accompanies a diagnosis of cancer is, in large part, due to the cultural myths and taboos surrounding the disease. Certain popular ideas about how cancer starts and spreads, though scientifically wrong, can seem to make sense, especially when those ideas are rooted in old theories. This can lead to needless worry and even hinder appropriate prevention and treatment decisions. Some of the common cancer myths include the notion that being diagnosed with cancer equates to a death sentence and that cancer is an individual's fate and not preventable. Preference for opting for alternative therapies

not backed by adequate scientific evidence for the treatment of cancer and considering these strategies as free of any side effects is another common myth. This can lead to delays in seeking medical care, resulting in cancer progression and decreasing survival outcomes. Cancer myths can create fear and anxiety in patients, causing them to worry about the effectiveness of their treatment, the likelihood of survival, and the potential side effects of treatment. This can have a negative impact on their mental health and quality of life. Some cancer myths suggest that certain foods or diets can cure cancer or prevent it from recurring.[5] Cancer is a disease where myth can bring an end to a life. Undoubtedly, cancer is still a dreadful challenge for oncologists and researchers but that does not stop us from combating this killer disease. Diagnosis of cancer does not indicate that the person is suffering from an incurable disease where death is inevitable. Therefore, the need of the hour is to emphasize on debunking innumerable myths and misconceptions associated with cancer.

<u>**Myth:**</u> **Only Smokers Get Oral Cancer** Contrary to popular belief, smoking is not the sole cause of oral cancer. While tobacco use, including both smoked smokeless forms, are major risk factors, other also contribute to the development of oral cancer. These include excessive alcohol consumption, human papillomavirus (HPV) infection, poor oral hygiene, and a family history of the disease. It's crucial to recognize that non-smokers can also be at risk, and a comprehensive understanding of all risk factors is essential for early detection and prevention.

Myth: Mouth Cancer Only Affects Older Individuals While the risk of developing mouth cancer increases with age, it can affect individuals of any age, including younger people. The prevalence of oral cancer in younger individuals is rising, emphasizing the importance of regular screenings and awareness campaigns targeting diverse age groups. Early detection is key, and everyone, regardless of age, should be vigilant about their oral health and seek medical advice if they notice any unusual symptoms.

Myth: Mouth Cancer is Rare, So Regular Check-ups Are Unnecessary

While it's true that mouth cancer is not as common as some other types of cancer, it is still a significant health concern. The incidence of oral cancer in the India has been on the rise, under scoring the importance of regular dental check-ups and screenings. Routine examinations by dental professionals can aid in the early detection of precancerous lesions or early-stage cancer, significantly improving treatment outcomes.

Myth: Mouth Cancer is Easy to Spot, So I Don't Need Regular Check-ups. One of the dangerous misconceptions is assuming that mouth cancer is always easily visible. In reality, early stages of oral cancer may be asymptomatic or present with subtle symptoms that are easy to overlook. Regular dental check-ups are crucial because professionals can identify abnormalities that may not be apparent to individuals. Visual examinations, along with advanced diagnostic tools, play a pivotal role in early detection, making regular dental visits a proactive step in preventing and managing mouth cancer.

Myth: Oral Cancer Is Not a Serious Health Issue. Oral cancer can have severe consequences if not detected and treated promptly. Delayed diagnosis can lead to the spread of cancer to other parts of the body, making treatment more challenging. Additionally, the impact on an individual's quality of life, including difficulties in eating, speaking, and facial disfigurement, underscores the seriousness of this disease. Education and awareness are crucial to dispel the myth that oral cancer is a minor concern, emphasizing the importance of prevention and early diagnosis.

Myth: Using a Mouthwash Can Prevent Mouth Cancer Debunked: While using mouthwash is an excellent practice for maintaining good oral hygiene, it alone cannot prevent mouth cancer. Good oral hygiene practices, including regular brushing, flossing, and using mouthwash, contribute to overall oral health, reducing the risk of various dental issues.

However, the prevention of mouth cancer requires a holistic approach, including avoiding tobacco and excessive alcohol consumption, maintaining a healthy diet, and scheduling regular dental check-ups.

Myth: Mouth Cancer is Always Painful Debunked: Contrary to the belief that mouth cancer always presents with pain, especially in the early stages, it can be asymptomatic or exhibit mild symptoms. Pain may only occur in later stages when the cancer has progressed. This highlights the importance of not relying solely on pain as an indicator of oral health.

Regular self-examinations, coupled with professional check-ups, are crucial for detecting any abnormalities or changes in the oral cavity, even in the absence of pain.

Myth: Mouth Cancer is Contagious Debunked: Mouth cancer is not contagious and cannot be transmitted from person to person through casual contact. The primary risk factors for developing oral cancer are related to lifestyle choices, genetic predisposition, and certain infections such as HPV.

Understanding that mouth cancer is not contagious helps dispel unnecessary fears and promotes a more informed and supportive community for individuals affected by the disease. Apart from cervical cancer (caused by human papilloma virus)[6] and liver cancer (caused by hepatitis B and C virus)[7], none of the other forms of cancer are contagious. **Myth: If There's No Lump, It Can't Be Cancer** Debunked: Unlike some other types of cancer, oral cancer may not always present as a visible lump. It can manifest as white or red patches, sores, or ulcers that do not heal. Additionally, changes in the texture or color of the tongue, persistent hoarseness, and difficulty swallowing can be indicative of oral cancer. Relying solely on the presence of a lump may lead to delayed diagnosis. Regular self-examinations and professional screenings are essential for detecting a range of potential symptoms.

Myth: Oral Health Doesn't Affect Overall Health Debunked: The health of your mouth is interconnected with your overall well-being. Neglecting oral health not only increases the risk of oral cancer but is also linked to various systemic health issues such as cardiovascular disease, diabetes, and respiratory infections. Maintaining good oral hygiene, adopting a healthy lifestyle, and attending regular dental check-ups contribute not only to preventing mouth cancer but also to promoting overall health and well-being.

Myth: Cancer is always fatal Debunked: Though there has been a sharp rise in cancer related mortality, but improved treatment options have made it possible for thousands of patients to improve survival rate.

Myth: Biopsies as well as surgery aggravates cancer. Debunked: Biopsies are the effective diagnostic tools for detection of cancer. Avoiding biopsies may lead to late detection and poor prognosis of the disease process. **Myth: Every abnormal growth is cancerous**. Debunked: Benign tumours do not possess the capability to metastasize. In case of any clinical problem, these can be surgically removed.[8]

Myth: Cancer is a hereditary disease. Debunked: Genetic predisposition is an important factor which contributes towards development of cancer, but all cancers are not liable to develop from genetic inheritance. Only 5-10% of all cancers are attributed to genetic defects and the remaining 90-95% have their strings attached to environment and lifestyle.

Myth: Nausea, sickness and pain are part and parcel of cancer treatment. Debunked: Individual variation exists regarding response to a particular treatment regimen. Recent advancements with anti-emetics have made it possible to reduce the side effects like nausea and sickness. Pain relieving medications and exercises provide better quality of life to the patients.

Myth: Clinical trials are highly experimental and patients are treated like "Guinea pigs" and are a risky undertaking. Debunked: Clinical trials generally incorporate the best available medicine and then add to it or adjust it to observe if enhancements can be made to improve the quality of life of patients or their response rates. Clinical trials are closely monitored by the doctors and caregivers, as well as an Institutional Review Board assigned to each trial and details are carefully documented.

Myth: Sugars feed cancer. Sugar is not responsible for the spread of cancer. Debunked: Excess intake of sugar can lead to obesity and, therefore, can enhance the risk of oral cancer. Naturally occurring sugars like those found in fruits, vegetables and whole grains are all needed to help maintain muscle and weight during cancer treatment and have been shown to help fight cancer.[8]

Myth: Positive attitude is enough to cure cancer. Debunked: Positive attitude is always desirable during cancer treatment but this cannot be the only option for cancer cure, since proper medication and therapy are the foremost priority in case of cancer patients.

Myth: There is no need to talk about cancer. Debunked: It is always good to have an open and frank discussion about cancer, which might help to create awareness, therefore, improving outcomes at an individual, community level.

Myth: One having cancer treatment cannot live at home, work or go about usual activities. Debunked: Very often patients need to get admitted to a hospital for treatment. At times it may be helpful to travel to a specialty medical centre for treatment. The truth is that many people with cancer may be treated on an outpatient basis. A great deal of effort is ongoing to make it easier for cancer patients to live a normal life during their treatment.

Myth: Supernatural factors and ill fate influence cancer. Debunked: Very often people attribute an illness to supernatural factor, ill fate and witch craft with the occurrence of cancer. These affect the well-being of the patients due to bereavement in decision making and delayed medical care.[8]

Myth: Cancer research is fruitless. Debunked: Oncology, the study and management of cancer, is the fastest evolving branch of modern medicine today. Though the cause of cancer is still an enigma, the advanced interdisciplinary research has increased the scope of fighting the disease. Cancer research has brought in a number of new molecules which has helped to blend the targeted therapy, hormone therapy along with better surgical options, radiotherapy and chemotherapy to improve the disease free survival of the cancer patients.[9]

2 | DISCUSSION

Not only myths, social taboos also are an obstacle in dealing with cancer. A diagnosis of cancer is a life changing event commonly evoking feelings of shock, fear, anger, sadness, loneliness and anxiety. Cancer remains taboo and people with cancer are even subjected to stigma and discrimination that may stop them from admitting that they have cancer. Negative public concept of cancer can perpetuate a cycle of fear and misinformation that hinders raising awareness about cancer prevention and the importance of early detection. Lack of awareness is the root cause of the oncologic misconceptions. Cancer awareness programmes are foremost initiatives which are needed to debunk these myths. In a pilot survey conducted by Chittaranjan National Cancer Institute, Kolkata, India, on 900 people to assess the level of cancer awareness only 8% had experiences any cancer awareness programme conducted by any organization, 37% had heard cancer awareness programme on All India Radio, 36% had viewed awareness programme on Doordarshan/ private television channels, 34% had read cancer awareness articles and only 13% had seen cancer awareness posters and hoardings (unpublished findings). The results envisaged a great lacuna in cancer awareness prevailing with the common mass.

The oncologic myths can be managed with effective palliative care services which would identify the misconceptions regarding cancer and help the patients as between health care providers and the community. According to the World Health Organization, majority of the cancer cases are detected only in the advanced stages, when they are untreatable. This has led to devastating consequences especially in developing countries. Educating people and spreading awareness against cancer and more organized network of cancer screening clinics would help to diagnose even an asymptomatic patient at an early stage. An early diagnosis of cancer and proper medical intervention would certainly lead to better prognosis and enhance the chances of disease free survival.

3 | CONCLUSION

Dispelling myths about oral cancer is a crucial step in promoting awareness and encouraging proactive measures for prevention and early detection. By staying informed, prioritizing regular check-ups, and adopting a holistic approach to oral health, individuals can contribute to reducing the impact of oral cancer on the population. Remember, knowledge is a powerful tool in the fight against oral cancer, and a well-informed community is better equipped to protect and prioritize their health.

Addressing these myths necessitates multifaceted approaches, including targeted education, public health initiatives, and collaborative efforts among healthcare professionals, researchers, and advocacy groups. By fostering a culture of knowledge dissemination and empowerment, individuals can make informed decisions about oral health practices and seek timely medical attention when necessary.

Conflict of Interest

The authors declare no conflict of interest.

REFERENCES:

1. Gupta B., Bray F., Kumar N., Johnson N.W. Associations between oral hygiene habits, diet, tobacco and alcohol and risk of oral cancer: a case–control study fromIndia. Cancer Epidemiol. 2017;51:7–14. doi: 10.1016/j.canep.2017.09.003.[PubMed] [CrossRef] [Google Scholar]

2. Ferlay J, Ervik M, Lam F, Colombet M, Mery L, Piñeros M, et al. Global cancer observatory:Cancer today. Lyon, France: International Agency for Research on Cancer; 2020. [accessed on August 5, 2022]. Available from:https://gco.iarc.fr/today . [Google Scholar]

3. Sharma S., Satyanarayana L., Asthana S., Shivalingesh K.K., Goutham B.S., Ramachandra S. Oral cancer statistics in India on the basis of first report of 29 population-based cancer registries. J. Oral Maxillofac. Pathol. 2018;22:18–26. doi: 10.4103/jomfp.JOMFP_113_17. [Google Scholar]

4. Veluthattil A., Sudha S., Kandasamy S., Chakkalakkoombil S. Effect of hypofractionated, palliative radiotherapy on quality of life in late-stage oral cavity cancer: a prospective clinical trial. Indian J. Palliat. Care. 2019;25:383. doi: 10.4103/IJPC.IJPC_115_18. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

5. Domínguez M, Sapiña L. From sweeteners to cell phones—Cancer myths and beliefs among journalism undergraduates. Eur J Cancer Care. 2020; 29:e13180.

6. Subramanya D, Grivas PD. HPV and cervical cancer: updates on an established relationship. Postgrad Med. 2008;120:7–13. [PubMed] [Google Scholar]

7. Forner A, Llovet JM, Bruix J. Hepatocellular carcinoma. Lancet.2012;379:1245–55. [PubMed] [Google Scholar]

8. Bray GA, Nielsen SJ, Popkin BM. Consumption of high-fructose corn syrup in beverages may play a role in the epidemic of obesity. AmJ Clin Nutr.2004;79:537–43. [PubMed] [Google Scholar]

9. Risch N. The genetic epidemiology of cancer: interpreting family and twin studies and their implications for molecular genetic approaches. Cancer Epidemiol Biomarkers Prev. 2001;10:733–41. [PubMed] [Google Scholar]

Author Guidelines

Author Guidelines

Editorial and Peer Review Process:

A manuscript will be reviewed for possible publication with the understanding that it is being submitted to World Journal of Dental Excellence alone at that point in time and has not been published anywhere, simultaneously submitted, or already accepted for publication elsewhere. On submission, editors will review all submitted manuscripts initially for suitability for formal review and plagiarism. Manuscripts with insufficient originality, serious scientific or technical flaws, or lack of a significant message will be rejected before proceeding for formal peer review. Manuscripts that are found suitable for publication in the World Journal of Dental Excellence are sent to two or more expert reviewers. The journal follows a double-blind review process, where the reviewers and authors are unaware of each other's identity. After considering the comments from the reviewers, each manuscript is assigned to a member of the editorial team who makes the final decision on its publication. The reviewers' comments and suggestions (acceptance/ rejection/amendments in the manuscript) are conveyed to the corresponding author. If required, the author is requested to provide a point-by-point response to reviewers' comments and submit a revised version of the manuscript. This process is repeated till reviewers and editors are satisfied with the manuscript. Within 3 weeks, the authors will be informed about the reviewers' comments and acceptance/rejection of their manuscript. Articles accepted would be copy edited for grammar, punctuation, print style, and format. To avoid delays in publication, authors are advised to adhere closely to the instructions given below.

Types of Articles and Word Limits:

Original articles: Original articles include randomized controlled trials, intervention studies, studies of screening and diagnostic tests, outcome studies, cost-effectiveness analyses, case control series, and surveys with high response rates. These articles must be written within 3000 words excluding references and abstract. A structured abstract of up to 250 words should be included with the following subheadings: Background, Methods, Results, and Conclusion. The content of the original article should be structured as Title, Authors, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Conclusion, Conflict of Interest, Acknowledgements, and References.

Review articles: Review articles include systemic critical assessments of literature and data sources. These kinds of articles must be written within 4000 words excluding references and abstract. An unstructured abstract of up to 250 words should be included.

Case reports or case studies: These should be short, decisive observations. These should be kept within 2000 words with not more than 15 references and up to 4 tables or figures. An unstructured abstract of up to 200 words should also be included. The content should have the following headings: Abstract, Keywords, Introduction, Case Presentation, Discussion, and References.

Short communications/brief reports: These follow a similar format as the Original Articles; however, the Results and Discussion sections in the main body of the text should be combined. The word count for Brief Reports should be kept within 1500 words in the main body of the text, with up to 15 references and not more than 2 tables or figures.

Letter to the editor/editorials: This can include comments on earlier publications, presenting data or findings in brief, expressing opinions on health-related issues, and communicating interesting case material. These should be of approximately 750-1000 words and not more than 10 references.

Preparation of Manuscript: Manuscripts must be prepared in accordance as recommended by the International Committee of Medical Journal Editors (http://www.icmje.org/icmje-recommendations.pdf) guidelines. The adherence to writing guidelines of the journal is important to uplift the quality of the publication. The general rule of writing an effective scientific article is to write as if the reader already knows the field in general but doesn't know what you did. Besides content, accuracy, relevance, and science, also pay attention to the writing style and formatting.

General requirements: All files should be in Microsoft Word file format (.doc, .docx). Abbreviations should be spelled out in full for the first time. Page size should be in Letter Portrait, A4 (8.5" × 11") and spacing between lines should be 1.5. The margin should be normal (2.54 cm on all sides). Font style should be Times New Roman and keep the font size 12 for all contents in the document except for the title (Title should be 14 Times New Roman, Bold, Capital case, Centre aligned). The corresponding author should include an asterisk.

Cover letter: The cover letter must state the material is original research, has not been previously published, and has not been submitted for publication elsewhere while under consideration. If the manuscript has been previously considered for publication in another journal, please include the previous reviewer comments, to help expedite the decision by the Editorial team.

Title

- Title of the article should be short, continuous, and yet sufficiently descriptive and informative.
- The title should be brief, informative, of not more than 15 words.
- A short running title not exceeding 10 words.

Author names and affiliations

Clearly indicate the provided name(s) and surname(s) of each author and check that all names are accurately spelled. Affiliations of all the authors should be provided below the list of authors with appropriate citations in numbers. An affiliation should include a department name, institute or university name, city name, and country name. The corresponding author's mailing address, designation, institution, and contact details (email, telephone, and fax numbers) should be provided. If authors regard it as essential to indicate that two or more co-authors are equal in status, they may be identified by an asterisk symbol with the caption 'These authors contributed equally to this work' immediately under the author affiliation list.

Abstract:

Original research articles follow the Background, Objectives, Methods, Results, and Conclusion structure for writing abstracts. An abstract should not be more than 250 words. The abstract should be brief and indicate the scope and significant results of the paper. It should only highlight the principal findings and conclusions.

Keywords:

There should be 4-6 keywords (MeSH headings).

Introduction:

An introduction should be brief and state precisely the scope and relevance of the study. It should be within a word limit of 400 words.

Materials & Methods:

Describe the selection of the observational or experimental subjects (patients or laboratory animals, including controls) clearly. Sample size calculation, exclusion and inclusion criteria, and description of the source population should be clear. Methods can be divided into subsections if required (e.g., study design, participants, sampling, sample size, research instrument, etc.). Details of research methods, procedures, and apparatus/tools used for conducting the study should be mentioned clearly. Provide references to established methods, including statistical methods; provide references and brief descriptions of methods that have been published but are not well known; describe new or substantially modified methods, give reasons for using them, and evaluate their limitations. When mentioning drugs, it should be in generic names (proprietary names can be provided in brackets). When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000. Do not use patients' names, initials, or hospital numbers, especially in illustrative material. When reporting experiments on animals, indicate whether the institution's or a national research council's guide for or any national law on the care and use of laboratory animals was followed. Authors should provide the details of statistical methods and software used for analysing the data.

Results:

Present the results in logical sequence in the text, tables, and figures. Tables and figures may be left at the respective location within the text. These should be numbered using Arabic numerals only. Do not repeat the results or data in the text, which are shown in the tables or figures. For qualitative studies, the authors are advised to present the quotations in the text or the boxes. When data are summarized in the Results section, give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical methods used to analyze them. P should always be capitalized and italicized (Examples: P=.049; P<0.001).

Discussion:

Emphasize the new and important aspects of the study and the conclusions that follow from them. Do not repeat the results or other material given in the Introduction or the Results section. Relate the observations to other relevant studies and include implications of the findings and their limitations, including implications for future research.

Conclusion:

This section should state the implications and how the study adds to existing knowledge. Link the conclusions with the aims of the study but avoid unqualified statements and conclusions not completely supported by your data. Recommendations, when appropriate, may be included.

Acknowledgment:

Acknowledgment should be brief and made for specific scientific/technical assistance and financial support only and not for providing routine departmental facilities and encouragement or for help in the preparation of the manuscripts (including typing or secretarial assistance).

The source of funding for the study, if available, must be cited under this section.

Conflict of interests:

All authors must declare their conflicts of interest. If there is a conflict, the author must declare in a separate section of the manuscript or in a cover letter.

References:

All the references must be listed at the end of the manuscript and all the listed references must be cited in the text. The Journals follows the official ICMJE (http://www.icmje.org/icmje-recommendations.pdf) Medlinestyle with minor alterations.

   a. If a reference has more than 3 authors, cite the first three and then insert "*et al.*" If a reference has 3 authors, all authors must be listed.
   b. State only the year of publication in the reference (not the date and month).
   c. Journal title should be abbreviated in Medline style. For journals not in PubMed, use the full journal name or the abbreviated name provided by the journal publisher.
   d. References in texts should be cited in superscript after the punctuation, without a bracket.
   e. For original articles, the number of references should not exceed 30. For review articles, the number of references should not exceed 45.

Examples of references

Journal

- Author names, article title, journal name, year of publication, volume number, page range
- Journal title is abbreviated in Medline style. For journals not in PubMed, use the full journal name or the abbreviated name provided by the journal publisher
- Use a condensed page number system
- Malick SM, Hadley J, Davis J, *et al.* Is evidence-based medicine teaching and learning directed at improving practice? J Royal Soc Med 2010;103(6):231-8.

Book

- Author names, book name, volume/edition number, year of publication, publisher name, city of publication.

- Bhushan V, Le T, Amin C, *et al.* First Aid for the USMLE Step 1. New York: McGrawHill; 2002.

Book Chapter

- Author names, chapter title, editor names, book title, volume/edition number, year of publication, city and state of publication, publisher name, and page range.
- Hadd FJ, Buckalew VM. Endogenous digitalis-like factors in hypertension. In: Laragh HJ, Brenner MB, eds. Hypertension: Pathophysiology, Diagnosis, and Management. New York, NY: Raven Press; 1995:1055-67.

Patent

Larsen CE, Trip R, Johnson CR, inventors; Novoste Corporation, assignee. Methods for procedures related to the electrophysiology of the heart. US patent 5529 067. 1995 Jun 25.

Electronic journal article

Morse SS. Factors in the emergence of infectious diseases. Emerg Infec Dis [serial online] 1995 Jan-Mar [cited 1996 Jun 5];1(1):[24 screens]. Available from: URL: http://www.cdc.gov/ ncidod/EID/eid.htm.

World Wide Web

- Format: Author/editor (surname initials). Title [online]. Year [cited year month day].

  Available from URL:.

- World Wide Web page McCook A. Pre-diabetic Condition Linked to Memory Loss [online]. 2003 [cited 2003 Feb 7]. Available from: URL: http://www.nlm.nih.gov/medlineplus/news/fullstory_11531.html

Figures/Tables/Images:

Figures, tables, and images must be cited in the order of their appearance in the manuscript. It should be numbered in chronological order. The title of the tables/figures must be as self-explanatory as possible. Figures and tables should be in an editable format. Pictures must be in high resolution (at least 300 dpi) and in JPEG format. The patient's identity should be protected by using an appropriate eye blinder. By default, table captions should be represented above the table and figure legends should be represented below the figure. Figures/Tables/Images should not be more than 6. All the additional figures and tables should be included as supplementary material.

How to submit manuscript

Pre-submission Enquiries: Pre-submission inquiries should be sent to the editorial office *via.* e-mail.

Online Submission of Manuscript

World Journal of Dental Excellence accepts articles only through mail id: editor@dscds.edu.in. For online submission, please provide your complete manuscript in the form of a single file (MS Word Format) containing all the material. Please place tables and figures in appropriate places in the text. Before submitting a manuscript, authors are encouraged to read the submission instructions carefully. You will be able to monitor the status of your manuscript online throughout the editorial process.

Submission of revisions: Authors submitting a revised manuscript after review are asked to include the following:

- A rebuttal letter, indicating point-by-point how you have addressed the comments raised by the reviewers. If you disagree with any of the points raised, please provide adequate justification in your letter.
- Manuscript revisions will be made by using track change or by highlighting in response to the reviewers' comments in order to aid the Editors and reviewers.
- A clean file and track change/highlighted manuscript should be submitted with a cover letter and rebuttal letter.

On Acceptance and Publication

Once the article is accepted for publication after the peer-review process, the editorial team will request all the authors to must complete and sign a copyright form (hard or scanned copy) and send it back to the editorial office for speedy processing of publication production, delay in sending the copyright form will result in delay of publication. The author must return the galley proof of their manuscript within 2-3 working days for fast processing of online publication.

Authorship and Contributorship

The Journal follows the guidelines provided by the International Committee of Medical Journal Editors (ICMJE) COPE's Core Practice guidance regarding authorship and contributorship.

1. Authorship Criteria:

- The journal requires that all authors meet the following criteria
- Substantial contributions to the conception or design of the work, or the acquisition, analysis, or interpretation of data for the work
- Drafting the work or revising it critically for important intellectual content
- Final approval of the version to be published
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolve.

2. Authorship Requirements

The journal requires that all authors:

- Have made significant contributions to the work and take responsibility for the content of the manuscript.

- Have read and approved the final version of the manuscript
- Agree to the submission of the manuscript to the journal
- Agree to be accountable for the accuracy and integrity of the work

3. Contributorship Statement

The journal requires a contributorship statement to be provided for each published article. The statement should list the specific contributions of each author to the work.

Examples of contributions may include:

- Conception and design of the study
- Acquisition and analysis of data
- Drafting or revising the manuscript
- Approval of the final version of the manuscript

4. Changes to Authorship

The journal requires that any changes to authorship (adding, deleting, or rearranging authors) be approved by all authors and documented in writing

5. Conflict of Interest

The journal requires that all authors disclose any potential or actual conflicts of interest related to the work being submitted.

6. Corresponding Author

The journal requires that one author be designated as the corresponding author and responsible for communicating with the journal during the submission, review, and publication process.

These policies on authorship and contributorship ensure that all authors of a published work have made significant contributions to the research and take responsibility for the accuracy and integrity of the work.