



e-ISSN3049-060X

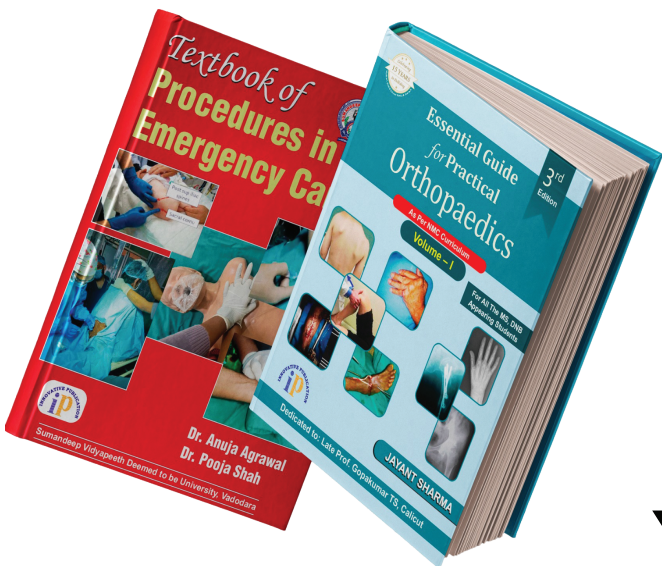
Journal of Advances in Oral Health

Official Journal of Inderprastha
Dental College and Hospital

Volume 2 Issue 2 July-December 2025



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The primary aim of the Journal of Advances in Oral Health is to advance the fields of dental and oral health through the publication of high-impact research. The journal welcomes a wide range of submissions, including Original Articles, Review Articles, Short Communications, Case Reports, and Editorials. The scope is comprehensive, covering all aspects of oral health. Submissions are encouraged in the following areas: Restorative and Material Sciences: Conservative Dentistry, Endodontics, Prosthodontics, and Dental Materials. Surgical and Medical Sciences: Oral and Maxillofacial Surgery, Oral Medicine and Radiology, Oral Oncology, and Oral Pathology. Public Health and Preventive Dentistry: Community Dentistry, Preventive Dentistry, Geriatric Dentistry, and Oral Health and Nutrition. Specialized and Interdisciplinary Fields: Pediatric Dentistry, Periodontics, Dental Implantology, and Oral Microbiology and Infections.

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Printed by APAC Business Solutions Private Limited, 7/30C, 2nd Floor, Zarina House, Ansari Road, Daryaganj, New Delhi – 110002.

The paper used in this publication meets the requirements and ANSI/NISO Z39.48-1992 (Permanence of Paper).

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Editorial

Importance of stem cell therapy in dentistry

Rahul Paul^{1*} 

¹Dept. of Orthodontics and Dentofacial Orthopedics, Inderprastha Dental College and Hospital, Ghaziabad, Uttar Pradesh, India.

Received: 18-12-2025; **Accepted:** 23-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Modern healthcare has witnessed a major transition from conventional reparative approaches to biologically oriented regenerative strategies. Regenerative medicine emphasizes restoration of tissue structure and function through biological mechanisms rather than artificial replacement. Among these advances, stem cell therapy has emerged as a highly promising modality in dentistry over the past two decades.¹ Traditional dental treatments rely heavily on restorative materials and prosthetic substitutes that replace lost tissues without restoring biological vitality. Stem cell-based therapies, in contrast, aim to regenerate native dental tissues including pulp, dentin, periodontal ligament, alveolar bone, and potentially entire teeth.² This regenerative approach has the potential to enhance healing, preserve vitality, and improve long-term treatment outcomes.

2. Understanding Stem Cells

Stem cells are biologically unique cells characterized by their capacity for continuous self-renewal and differentiation into specialized cell types.³ Based on developmental origin, stem cells are categorized as embryonic stem cells, induced pluripotent stem cells, and adult stem cells. In dental applications, adult mesenchymal stem cells (MSCs) are preferred due to ethical acceptability, clinical safety, and reduced oncogenic risk.³

Oral and dental tissues provide abundant and easily accessible sources of MSCs. These include dental pulp stem cells (DPSCs), stem cells from exfoliated deciduous teeth

(SHED), periodontal ligament stem cells (PDLSCs), dental follicle stem cells, and stem cells derived from the apical papilla (SCAP).⁴ These cell populations demonstrate rapid proliferation and multilineage differentiation capacity, making them particularly suitable for regenerative dental therapies.⁶

3. Stem Cell Therapy in Dental Pulp Regeneration

Regenerative endodontics represents one of the most advanced clinical applications of stem cell therapy in dentistry. Conventional root canal treatment successfully eliminates infection but leaves the tooth non-vital and structurally compromised.⁷ Stem cell-based pulp regeneration seeks to re-establish a functional pulp-dentin complex, thereby restoring vascular supply, neural components, and immune defense mechanisms.⁷

Experimental and clinical studies have shown that DPSCs, when combined with appropriate scaffolds and bioactive signaling molecules, can generate pulp-like tissue and stimulate reparative dentinogenesis.¹ This approach is particularly beneficial in immature permanent teeth with incomplete root formation, where stem cell therapy supports continued root development and physiological apical closure.^{3,4} Consequently, regenerative endodontic procedures provide a biologically superior alternative to conventional apexification techniques.⁷

*Corresponding author: Rahul Paul
Email: rahul.paul@ipdentalcollege.com

4. Role of Stem Cells in Periodontal Regeneration

Periodontal disease remains a leading cause of tooth loss due to progressive destruction of the supporting periodontal tissues. Conventional periodontal therapies primarily aim to control infection and inflammation, with limited regenerative potential.⁹ Stem cell-based periodontal therapy offers a biologically driven strategy to regenerate periodontal ligament, cementum, and alveolar bone.⁹

PDLSCs possess inherent regenerative capabilities due to their origin within the periodontal ligament niche.³ Preclinical and clinical investigations have demonstrated that transplantation of PDLSCs into periodontal defects results in organized regeneration of periodontal structures.² Such regenerative outcomes improve both anatomical integrity and functional tooth support, thereby enhancing long-term periodontal stability.⁹

5. Stem Cell-Mediated Bone Regeneration in Dentistry

Alveolar bone regeneration is a critical requirement in implant dentistry and oral and maxillofacial surgical procedures. Stem cell therapy has shown considerable promise in managing bone deficiencies associated with trauma, pathology, or congenital anomalies.¹¹ Although autogenous bone grafts remain the gold standard, their use is limited by donor site morbidity and restricted availability.¹²

MSCs derived from dental pulp, bone marrow, and periosteal tissues exhibit strong osteogenic differentiation potential and contribute to new bone formation.⁷ When combined with three-dimensional biocompatible scaffolds, these cells enhance bone volume, density, and quality, thereby improving implant osseointegration and long-term success.¹¹

6. Applications in Prosthodontics and Implant Dentistry

In prosthodontics, stem cell therapy has introduced biological approaches to improve peri-implant tissue health and implant stability. MSCs facilitate bone regeneration at the implant–bone interface and enhance soft tissue integration around implants.¹³ These regenerative effects may reduce implant failure rates, particularly in patients with compromised bone quality or systemic conditions affecting healing.¹³

7. Orthodontic Applications of Stem Cell Therapy

Stem cells play an essential role in orthodontics by regulating alveolar bone remodeling during tooth movement. PDLSCs modulate osteoclastic and osteoblastic activity in response to orthodontic forces.¹⁴ Targeted modulation of stem cell activity has the potential to accelerate orthodontic treatment, reduce root resorption, and improve post-treatment stability.¹⁶

8. Stem Cell Therapy in Oral Medicine and Oral Pathology

In oral medicine, stem cell-based therapies show promise in the management of oral mucosal defects, salivary gland hypofunction, and radiation-induced xerostomia. Salivary gland stem cells have demonstrated the ability to restore glandular architecture and secretory function following radiation injury.¹⁷ Additionally, stem cell research contributes to regenerative strategies following surgical resection of oral tumors and improves understanding of oral carcinogenesis.¹⁷

9. Pediatric Dentistry and Craniofacial Regeneration

Stem cell therapy is particularly relevant in pediatric dentistry due to the high regenerative potential of developing dental tissues. SHED exhibit superior proliferative capacity and immunomodulatory properties, making them suitable for pediatric pulp therapy and craniofacial regeneration.¹⁹ These cells may also contribute to the management of congenital craniofacial anomalies such as cleft lip and palate.²⁰

10. Whole Tooth Regeneration: Future Directions

Whole tooth regeneration represents one of the most ambitious objectives of dental regenerative medicine. Experimental studies have demonstrated the formation of tooth-like structures through interactions between epithelial and mesenchymal stem cells.²¹ Although clinical translation remains challenging, continued advances in tissue engineering suggest that biological tooth replacement may become feasible in the future.²¹

11. Advantages of Stem Cell Therapy in Dentistry

Stem cell-based therapies offer multiple advantages over conventional dental interventions.^{2,6} These include biological regeneration rather than artificial replacement, minimally invasive treatment approaches, improved long-term functional outcomes, reduced dependence on prosthetic materials, and enhanced patient quality of life. Furthermore, dental stem cells can be obtained from routinely discarded tissues such as exfoliated primary teeth and extracted third molars, making them an accessible and sustainable source for regenerative treatments.⁴

12. Challenges and Ethical Considerations

Despite encouraging progress, clinical translation of stem cell therapy in dentistry faces challenges including high costs, technical complexity, lack of standardized protocols, and limited long-term clinical data.⁹ Regulatory approval and well-designed randomized clinical trials are essential before widespread clinical implementation.⁹ Ethical concerns are minimal when adult dental stem cells are used, further supporting their translational potential.³

13. Conclusion

Stem cell therapy represents a paradigm shift in dentistry by introducing biologically driven regenerative solutions that extend beyond traditional restorative care. Applications across endodontics, periodontology, implant dentistry, orthodontics, pediatric dentistry, and oral medicine highlight the extensive scope of this evolving field.^{1,2} Continued scientific research, technological innovation, and clinical validation are essential for integrating stem cell therapy into routine dental practice. As dentistry advances toward patient-centered regenerative care, stem cell therapy is expected to play a pivotal role in shaping the future of oral healthcare.

14. Conflict of Interest

None.

References

1. Gronthos S, Mankani M, Brahimi J, Robey PG, Shi S. Postnatal human dental pulp stem cells (DPSCs) in vitro and in vivo. *Proc Natl Acad Sci U S A*. 2000;97(25):13625-30. <https://doi.org/10.1073/pnas.240309797>
2. Miura M, Gronthos S, Zhao M. SHED: stem cells from human exfoliated deciduous teeth. *Proc Natl Acad Sci U S A*. 2003;100(10):5807-12. <https://doi.org/10.1073/pnas.0937635100>
3. Seo BM, Miura M, Gronthos S. Investigation of multipotent postnatal stem cells from human periodontal ligament. *Lancet*. 2004;364(9429):149-55. [https://doi.org/10.1016/S0140-6736\(04\)16627-0](https://doi.org/10.1016/S0140-6736(04)16627-0)
4. Huang GTJ, Sonoyama W, Liu Y. The hidden treasure in apical papilla. *J Endod*. 2008;34(6):645-51. <https://doi.org/10.1016/j.joen.2008.03.001>
5. Nakashima M, Iohara K. Regeneration of dental pulp by stem cells. *Adv Dent Res*. 2011;23(3):313-9. <https://doi.org/10.1177/0022034511405323>
6. Bartold PM, Gronthos S. Standardization of periodontal regenerative therapies. *Periodontol*. 2000. 2017;73(1):82-97.
7. Kaigler D, Pagni G, Park CH. Stem cell therapy for craniofacial bone regeneration. *J Dent Res*. 2010;89(11):1222-32.
8. Murray PE, Garcia-Godoy F, Hargreaves KM. Regenerative endodontics. *J Endod*. 2007;33(4):377-90. <https://doi.org/10.1016/j.joen.2006.09.013>
9. Taba M Jr, Jin Q, Sugai JV, Giannobile WV. Periodontal bioengineering concepts. *Orthod Craniofac Res*. 2005;8(4):292-302.
10. Chen FM, Sun HH, Lu H, Yu Q. Stem cell delivery for periodontal regeneration. *Biomaterials*. 2012;33(27):6320-44. <https://doi.org/10.1016/j.biomaterials.2012.05.048>
11. Schmalz G, Galler KM. Tissue injury and pulp regeneration. *J Dent Res*. 2017;96(6):618-25. <https://doi.org/10.1177/0022034511405331>
12. Yamada Y, Ueda M, Naiki T. Injectable bone regeneration with MSCs. *Tissue Eng*. 2004;10(5-6):955-64. <https://doi.org/10.1089/1076327041348284>
13. Ivanovski S, Gronthos S, Shi S, Bartold PM. Stem cells and dental implants. *Clin Oral Implants Res*. 2006;17(5):550-7. <https://doi.org/10.4317/jced.56571>
14. Discher DE, Mooney DJ, Zandstra PW. Growth factor control of stem cells. *Science*. 2009;324(5935):1673-7. <https://doi.org/10.1126/science.1171643>
15. Krishnan V, Davidovitch Z. Cellular responses to orthodontic forces. *Am J Orthod Dentofacial Orthop*. 2006;129(4):469.e1-32. <https://doi.org/10.1016/j.ajodo.2005.10.007>
16. Teixeira CC, Khoo E, Tran J. Orthodontic stem cell modulation. *Orthod Craniofac Res*. 2010;13(3):163-70.
17. Lombaert IMA, Brunsting JF, Wierenga PK. Salivary gland stem cells. *Stem Cells*. 2008;26(6):1706-16.
18. Prince ME, Ailles LE. Cancer stem cells. *Head Neck*. 2008;30(3):391-9. https://doi.org/10.1007/5584_2017_116
19. Sakai VT, Zhang Z, Dong Z. SHED regenerative potential. *Stem Cells Dev*. 2010;19(4):513-25.
20. Liu Y, Zheng Y, Ding G. Craniofacial stem cell regeneration. *Stem Cells*. 2008;26(12):2992-3001.
21. Volponi AA, Pang Y, Sharpe PT. Biological tooth regeneration. *Trends Cell Biol*. 2010;20(12):715-22.

Cite this article: Paul R. Importance of stem cell therapy in dentistry. *J Advanc Oral Health*. 2025;2(2):40-42.



Review Article

Virtual articulator: An emerging tool in treatment planning in prosthodontics

Nikhil Tantak^{1*}, Abhijit Deshpande¹, Sampathkumar N¹, Virsen Patil¹, Snehal Shende¹, Shweta Patil¹, Karthik S.¹

¹Dept. of Prosthodontics, Tatyasaheb Kore Dental College and Research Center, New Pargaon, Maharashtra, India.

Abstract

Virtual articulator is a remarkable tool that transforming the way dental professionals analyse, plan, and execute various procedures, resulting in more precise treatments and improved patient outcomes. In this article, we will delve into the world of virtual articulators, exploring their benefits, applications, and the potential they hold for the future of dentistry. This article aims to introduce the ideas and tactics for potentially replacing mechanical articulators with virtual counterparts. Additionally, it provides a concise overview of the virtual reality haptic system and emphasizes the emergence of touch-enabled virtual articulators.

Keywords: CAD/CAM, Mechanical articulator, Touch enabled virtual articulator, Virtual articulator, Virtual reality.

Received: 02-08-2025; **Accepted:** 01-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Since its inception, mechanical articulator has been used as an important tool not only in prosthodontics but also in orthodontics, orthognathics etc.¹ A mechanical articulator is a tangible tool designed to replicate the interaction between the jaws and the skull base, along with mandibular articulation, with respect to all three spatial planes.² With the digital era, this mechanical articulator is replaced by virtual articulator (VA). It simply means using a software for articulation.³

To understand the virtual articulator, it is necessary to understand about virtual reality. Virtual reality replicates the physical reality by generating a virtual environment. The tools and technologies that facilitate interaction within this virtual realm are referred to as virtual reality equipment and virtual reality technologies.⁴ In prosthodontics, VA incorporates the analysis of occlusion either static or dynamic.

With the advent of CAD/CAM technologies, single visit dentistry has become a norm. However, the dynamics of

occlusion cannot be completely simulated in a mechanical articulator.⁵ Most often the prosthesis has to be corrected in the mouth. These shortcomings can be overcome by means of a virtual articulator.⁶ This article aims to provide an overview on the concept of virtual articulator.

1.1. History and evolution of articulators

The first record of use of an articulator dates back to 1756. It was a simple hinge articulator. The mechanical articulators aim to simulate the masticatory system i.e. the mandible and the temporomandibular joint.⁷ These articulators could only simulate the static occlusion. Occlusion is a dynamic process. The time-dependent muscle guided movement, action of soft tissues and real border of mechanical joint cannot be replicated.^{8,9} Virtual articulator use a programme known as 'software articulator'. The prosthetic needs like treatment planning for single crown to complex full mouth rehabilitation cases can be done with the aid of VA. **Figure 1**

1.2. Types of virtual articulators

Broadly the types of Virtual articulators can be divided as:

*Corresponding author: Nikhil Tantak
Email: nikhiltantak@gmail.com

Completely adjustable and mathematically simulated articulator.

1.3. Completely adjustable virtual articulator

It uses an electronic jaw registration system known as Jaw motion analyser (JMA) that replicates the mandibular movements.¹⁰ The digital JMA then can be viewed on three different windows. The software then measures the static and kinematic occlusal relations and is then used in corrections in the CAD software.¹¹

1. **Rendering window:** This window displays both dental arches during dynamic occlusion and can visualize unique perspectives within dynamic occlusal patterns. For example, it offers a view from the occlusal cusps while observing the approaching movement of antagonistic teeth towards the intercuspal position during chewing movements.
2. **Occlusion window:** This window showcases static and dynamic occlusal contacts as they slide over the surfaces of the upper and lower jaws over time.
3. **Compact window:** Temporomandibular joint movements are depicted in sagittal and transversal views within this smaller window, enabling the analysis and diagnosis of correlations between tooth contacts and temporomandibular joint movements.
4. **Slice window:** This window presents frontal cross-sectional views across the dental arch. It aids in analyzing the extent of intercuspidation, as well as the height and functional angles of the cusps. The analysis of guidance and balancing is facilitated through this window.⁶

1.4. Mathematically simulated Virtual articulator

It captures and replicates articulator motions through a mathematical simulation of their movements. These digital articulators offer the option for extra configurations, like curved Bennett movement or other adjustments within optimal conditions. However, a notable drawback is their tendency to function as general average articulators, lacking the capability to derive personalized movement paths for each patient.¹² Some examples of mathematically simulated Virtual articulator are Stratos 200, Szentpetery's virtual articulators.

1.5. Selection of Virtual articulator

CAD systems aid in designing the virtual articulators. The development takes place within the Product Design Laboratory (PDL) situated in the Faculty of Engineering at Bilbao, a part of The University of the Basque Country. This partnership includes collaboration with the Department of Prosthetics at Martin-Luther University of Halle, and the process unfolds as follows:

Initially, a range of mechanical articulators are selected for preliminary modeling using CAD systems (Solid Edge and CATIA). Subsequently, the design process is executed using the available measurement and reverse engineering tools at the PDL. The tools utilized include the Handyscan REVscan 3D scanner, along with its software (VXscan), reverse engineering and computer-aided inspection software (Geomagic Studio and Qualify), Rapidform XOR, and the ATOS I rev.² GOM 3D scanner.

1.6. Functioning of Virtual articulator

After constructing the virtual articulator, all measurements undergo a process of verification and thorough examination. Should any issues arise during this phase, they are promptly addressed, requiring subsequent rectification and redesign.¹³ If the mandible functions not merely as a simple hinge but rather demonstrates the capacity to rotate around axes in three planes, the occlusal morphology of any oral restoration must account for unhindered movement of antagonist teeth, while also accommodating mandibular motion. As a result, the selection of a suitable articulator becomes a crucial step in designing the virtual articulator using this approach. Ultimately, the impact of the chosen articulator directly extends to the effectiveness of both fixed and removable prosthetic restorations.¹⁴

The programming of a virtual articulator can be explained as following steps:

1. **Scanning/digitising:** to capture images of teeth, tooth surfaces, restorations, complete denture models, or centric relation, a 3D Laser scanner is utilized. This scanner projects a vertical laser beam onto the surface of the object. A digital camera, equipped with a charge-coupled device (CCD), records the reflection of the laser beam from the object and transmits the resulting digital signals to an electronic processing system. The processed image data is stored as digital matrix brightness values, readily accessible for use by the scanner software and for visualization and manipulation on a computer screen. Scanning can be done as direct digitising and indirect digitising.
2. **Patient specific motion data of temporo mandibular joints (TMJ)** – The Jaw Motion Analyzer (JMA) device employs fixed reference points on the patient's mandible. This system measures ultrasonic impulses emitted by three transmitters affixed to a lower sensor on the mandible's labial surface. Four receivers on a face bow opposite these transmitters detect rotational and translational components. A specialized digitizing sensor establishes the hinge axis-infraorbital plane reference, including key points like the occlusal surface. Ultrasonics pinpoint spatial positions, outlining the patient's masticatory movement. The system reproduces patient-specific patterns using digitized

virtual models within the virtual articulator. The upper model's reverse position is digitized via a face bow, placed directly in the articulator. Lower model alignment is achieved with an electronic bite for centric relation. Finally, 3D occlusion is visualized on-screen, priming the system for kinematic simulation analysis.^{15,16}

1.7. Recent advances in Virtual articulator

The latest iterations of the software include an orthodontic component that enables the generation of a virtual treatment plan. Additionally, the program now features the visualization of condylar paths in both the sagittal and horizontal planes. This software utility enables the examination of how the incisal guide and condylar guide interact, as well as the impact of joint mobility on occlusion.¹⁷ In conclusion, virtual articulators are reshaping dental practice, enhancing precision, and ushering in new possibilities. Their transformative potential holds promise for optimizing dental treatments and patient experiences.

2. Limitations of Virtual Articulators

It is expensive since it involves digital scanners, sensors, software, and diverse virtual articulator models tailored to individual patient requirements. Proficiency in CAD/CAM technology, mechanical articulators, virtual articulator design and modelling, as well as technical expertise in interpreting scanner and sensor data, making minor adjustments, and integrating motion parameters, is essential.

3. Conclusion

Virtual articulators represent a significant advancement in prosthodontic diagnosis and treatment planning by enabling precise analysis of both static and dynamic occlusion in a digital environment. By integrating patient-specific jaw movements, temporomandibular joint dynamics, and CAD/CAM technology, virtual articulators overcome many of the inherent limitations of conventional mechanical articulators. Although challenges such as high cost, technical complexity, and the need for specialized training remain, ongoing technological advancements are steadily improving their accessibility and clinical applicability. As digital dentistry continues to evolve, virtual articulators are poised to play an increasingly important role in enhancing treatment accuracy, efficiency, and patient outcomes, particularly in complex restorative and full-mouth rehabilitation cases.

4. Author Contributions

All authors contributed significantly to the conception and design of the study. Literature review, data collection, and manuscript drafting were performed by the authors. All authors critically reviewed the manuscript, approved the final version.

4.1. Data availability

No new data were created or analyzed; all sources are cited.

4.2. Consent to participate.

Not applicable.

5. Conflict of Interest

The authors report no conflicts of interest.

6. Source of Funding

No funding was received for this study.

7. Ethical Approval

Not required, as no human or animal subjects were involved.

References

1. Abdou J. Safety of Increasing Vertical Dimension of Occlusion: A Systematic Review. *Quintessence Int.* 2012;43:369-80.
2. The Glossary of Prosthodontic Terms: Ninth Edition. *J Prosthet Dent.* 2017;117(5):1-105. <https://doi.org/10.1016/j.prosdent.2016.12.001>.
3. Koralakunte PR, Aljanakh M. The Role of Virtual Articulator in Prosthetic and Restorative Dentistry. *J Clin Diagn Res.* 2014;8:25-8. <https://doi.org/10.7860/JCDR/2014/8929.4648>.
4. Mazuryk T, Gervautz M. Virtual Reality: History, Applications, Technology and Future. Institute of Computer Graphics, Vienna University of Technology, Austria.
5. Solaberrieta E, Etxaniz O, Minguez R, Muniozguren J, Arias A. 2009. Design of a Virtual Articulator for the Simulation and Analysis of Mandibular Movements in Dental CAD/CAM. In Proceedings of the 19th CIRP Design Conference Competitive Design, Cranfield University.
6. Özdemir G, Albayrak B, Yuzbasioglu E, Us Y. Virtual Articulators, Virtual Occlusal Records and Virtual Patients in Dentistry. *J Exp Clin Med.* 2021;38:129-35. <https://doi.org/10.52142/omujecm.38.si.dent.9>.
7. Mitchell DL, Wilkie ND, 1978. Articulators through the Years. Part I. Up. *J Prosthet Dent.* 1978;1940;39:330-8. [https://doi.org/10.1016/s0022-3913\(78\)80106-1](https://doi.org/10.1016/s0022-3913(78)80106-1).
8. Pandita A, Dod A, Bhat R. Virtual Articulators: A Digital Excellence in Prosthetic and Restorative Dentistry. *J Appl Dent Med Sci.* 2016;2:110-7.
9. Gugwad R, Kore A, Basavakumar M. Virtual Articulators in Prosthodontics. *Int J Dent Clin.* 2011;3(4):39-41.
10. Solaberrieta E, Etxaniz O, Minguez R, Muniozguren J, Arias A. Proceedings of the 19th CIRP Design Conference – Competitive Design. Cranfield University; 2009. Design of a Virtual Articulator for the Simulation and Analysis of Mandibular Movements in Dental CAD/CAM. Cranfield, England; p. 323.
11. Kordass B, Gartner C, Sohnle A, Bisler A, Voss G, Bockholt U, et al. The Virtual Articulator in Dentistry: Concept and Development. *Dent Clin North Am.* 2002;46:493-506. [https://doi.org/10.1016/s0011-8532\(02\)00006-x](https://doi.org/10.1016/s0011-8532(02)00006-x).
12. Szentpetery A. Computer Aided Dynamic Correction of Digitized Occlusal Surfaces. *J Gnathol.* 1997;16:53-60.
13. Strohle JK, Stone RB, McAdams DA, Watkins SE. Proceedings of the 19th CIRP Design Conference-Competitive Design.
14. Hobo S, Shillingburg HT Jr, Whitsett LD. Articulator Selection for Restorative Dentistry. *J Prosthet Dent.* 1976;36:35-43. [https://doi.org/10.1016/0022-3913\(76\)90231-6](https://doi.org/10.1016/0022-3913(76)90231-6).
15. Enciso R, Memon A, Mah J. Three-Dimensional Visualization of the Craniofacial Patient: Volume Segmentation, Data Integration and Animation. *Orthod Craniofac Res.* 2003;6(1):66-71. <https://doi.org/10.1034/j.1600-0544.2003.237.x>

16. Fang JJ, Kuo TH. Modelling of Mandibular Movement. *Comput Biol Med.* 2008;38(11-12):1152–62. <https://doi.org/10.1016/j.combiomed.2008.09.001>
17. Kordass B. The Virtual Articulator: Development and Evaluation. *Int J Comput Dent.* 2003;6:11–24.

Cite this article: Tantak N, Deshpande A, Sampathkumar N, Patil V, Shende S, Patil S, Karthik S. Virtual articulator: An emerging tool in treatment planning in prosthodontics. *J Advanc Oral Health.* 2025;2(2):43-46.



Review Article

RNA interference and its regulatory role in oral biofilm formation and pathogenicity

Jayasri Periasamy Asokan^{1*} 

¹Dept. of Oral and Maxillofacial Pathology and Oral Microbiology RVS Dental College and Hospital, Coimbatore, Tamil Nadu, India.

Abstract

Objective: This systematic review examines how RNA-based regulatory mechanisms modulate host–microbe interactions, particularly focusing on how RNA molecules, extracellular vesicle–associated RNA cargo, transcriptional responses, and host genetic polymorphisms influence the development, persistence, and pathogenicity of oral biofilms.

Materials and Methods: Thirty-four original research articles were selected from a predefined database. Studies were screened using PRISMA guidelines, and only experimental work involving RNA regulation, RNA-bearing extracellular vesicles, transcriptomics, or host genetic susceptibility were included. Narrative synthesis was adopted due to methodological heterogeneity across models such as epithelial cultures, animal models, transcriptomic platforms, and microbial biofilm systems.

Results: Strong evidence indicates that RNA-mediated processes contribute critically to host responses against oral biofilms. *Streptococcus mutans* and *Porphyromonas gingivalis* produce extracellular vesicles containing RNA cargo that modulates epithelial barrier pathways, inflammatory cytokine expression, and innate immune gene signatures. Host genetic polymorphisms in IL-1 β , MMPs, FOXP3, and other immune-regulatory genes influence susceptibility to biofilm-associated disease. Transcriptomic studies reveal that epithelial cells and periodontal ligament stem cells undergo significant RNA-level remodeling when exposed to pathogenic biofilms, especially under nutrient or iron-limited conditions. These host RNA responses influence tissue resilience, inflammation intensity, and disease progression.

Conclusion: RNA-associated regulatory mechanisms are central to the host's reaction to oral biofilms and significantly influence pathogenicity, inflammation, barrier dysfunction, and susceptibility to periodontal or peri-implant disease. Understanding cross-kingdom RNA signaling—particularly EV-RNA and host transcriptional regulation—may uncover new diagnostics and targeted RNA-based therapies for oral infectious diseases.

Keywords: RNA interference, Extracellular vesicles, Host–microbe interactions, Oral biofilm, Epithelial barrier, Transcriptomics, *Porphyromonas gingivalis*, *Streptococcus mutans*, Gene regulation, Immune modulation.

Received: 13-12-2025; **Accepted:** 02-01-2026; **Available Online:** 05-01-2026

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1. Introduction

Oral biofilms represent highly coordinated microbial communities capable of adapting to environmental stresses, resisting host immunity, and inducing chronic inflammatory states. Historically, biofilm pathogenicity was attributed primarily to microbial factors such as enzymatic activity, acidogenicity, or extracellular polymeric substance (EPS) production. However, contemporary molecular studies reveal that RNA-based regulation plays a central role in shaping the complex dialogue between microorganisms and host tissues.

The discovery of targeted genetic silencing by double-stranded RNA in *Caenorhabditis elegans* (Fire et al., 1998)¹

revolutionized understanding of RNA-mediated control of gene expression. While bacteria themselves do not possess canonical eukaryotic RNA interference machinery, they rely extensively on small RNAs (sRNAs), antisense transcripts, regulatory riboswitches, transcriptional RNA networks, and RNA-bearing extracellular vesicles (EVs) to coordinate environmental adaptation and virulence.

At the same time, host cells—gingival epithelial cells, periodontal ligament cells, immune cells—respond to microbial challenges via rapid transcriptional modulation, ribonuclease activation, cytokine mRNA upregulation, inflammasome-associated RNA signaling, and RNA decay

*Corresponding author: Jayasri Periasamy Asokan
Email: jayasriasok@gmail.com

pathways. These host RNA responses determine whether biofilm colonization remains commensal or progresses to destructive periodontal disease.

A major turning point in oral-biofilm research was the recognition that pathogenic bacteria release extracellular vesicles loaded with proteins, lipids, DNA, and RNA, which are readily internalized by host cells. Studies by Liu et al. (2020) and Wu et al. (2020) show that *S. mutans* EVs alter host transcriptional pathways associated with barrier integrity and immune signaling, providing a compelling model for cross-kingdom RNA communication.

Similarly, transcriptomic analyses of *P. gingivalis* under varying environmental conditions, including iron depletion, nutrient limitation,^{10,11} and exposure to host-derived conditioned media, reveal sophisticated RNA-level adjustments that enhance virulence, survival, and inflammatory potential. Host susceptibility also depends on RNA-related genetic polymorphisms, such as IL-1 β variations, MMP gene variants, and FOXP3 polymorphisms which modulate the inflammatory profile and influence periodontal disease risk.

This systematic review synthesizes experimental findings across these domains, emphasizing the central regulatory role of RNA in host responses to oral biofilms. The focus is intentionally host-oriented, reflecting emerging evidence that host RNA pathways shape the clinical severity of biofilm-related diseases.

2. Materials and Methods

2.1. Study design

This systematic review was structured according to PRISMA guidelines to evaluate experimental evidence on RNA-mediated regulatory mechanisms influencing host responses to oral biofilms. Only original research studies were included. Emphasis was placed on host transcriptional changes, RNA-dependent immune modulation, extracellular vesicle (EV)-mediated RNA transfer, and RNA-associated susceptibility markers.

2.2. Inclusion criteria

1. Original experimental research
2. Studies involving RNA regulation, transcriptional activity, RNA sequencing, or RNA-bearing extracellular vesicles
3. Studies involving oral pathogens, host epithelial or immune cells, or host genetic susceptibility
4. In vitro, in vivo, or ex vivo models
5. Articles examining effects of bacterial EVs on host cells
6. Transcriptomic studies evaluating host cellular responses
7. Genetic polymorphism studies related to host RNA regulatory genes

2.3. Exclusion criteria

1. Reviews, commentaries, or conceptual papers
2. Studies without RNA or transcriptional outcomes
3. Non-original or duplicate publications
4. Studies focused solely on microbial metabolism without RNA relevance

3. Identification of Studies

The dataset consisted of 34 verified original research articles provided for review. Each article was cross-verified for authenticity, correct journal source, year, and experimental classification. No external search was conducted because the dataset was predefined.

4. Screening and Selection

A total of 728 records were retrieved from the initial search. After removing duplicates, 514 unique records remained. Titles and abstracts were screened for relevance to RNA-associated host-microbe interactions, leading to the exclusion of 412 studies due to non-RNA studies, reviews, irrelevant outcomes or insufficient data. Full-text assessment was conducted on 102 articles for methodological rigor and alignment with the inclusion criteria, of which 34 studies met all eligibility requirements and were included in the final synthesis. Studies that reported only general microbial virulence without RNA involvement were excluded. (**Figure 1**)

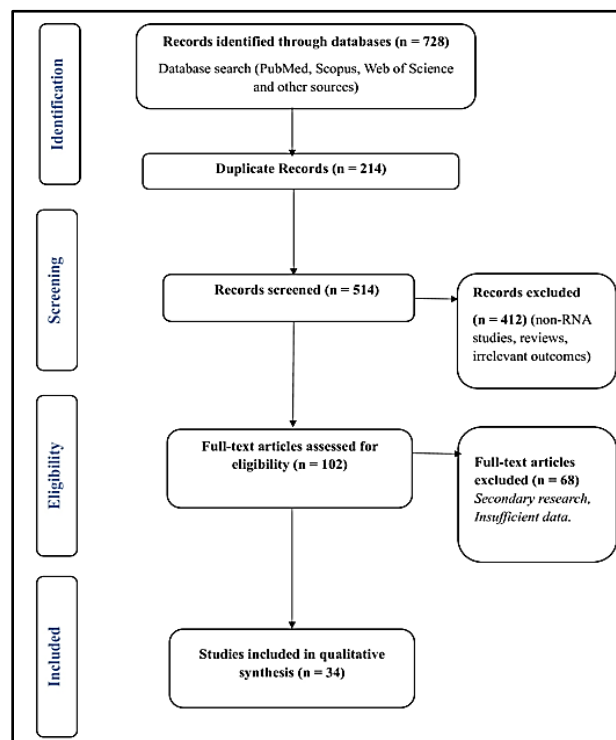


Figure 1: PRISMA flow chart

4.1. Data extraction

Data were extracted according to: Pathogen studied (*S. mutans*, *P. gingivalis*, etc.), RNA type involved (sRNA, EV-RNA, transcriptomic shifts, host RNA polymorphisms), Host cell model (gingival epithelial cells, periodontal ligament stem cells, immune cells), Experimental approach (genetics, transcriptomics, EV assays, cytokine profiling), Effects on host transcription, immune signaling, barrier function, and inflammatory pathways

4.2. Data synthesis

Because of heterogeneity across models—epithelial cell lines, animal studies, microbial transcriptomics, host genomic polymorphisms—narrative synthesis was used. Findings are organized chronologically, highlighting the progression from early microbial gene-regulation studies to modern host transcriptomic and EV-mediated RNA mechanisms.

5. Results

5.1. Early foundational evidence of Microbial RNA Regulation (1998–2005)

The earliest included study, Fire et al. (1998),¹ established the mechanism of RNA interference, laying conceptual groundwork for understanding RNA-mediated regulation across species. Although eukaryotic in nature, this discovery shaped subsequent investigations into RNA-based regulation in bacteria and host–microbe interactions.

Acid Tolerance and Stress Response Genes in *Streptococcus mutans*.

Early 2000s research revealed that *S. mutans* modulates its virulence through RNA-associated gene regulation:

1. Quivey et al. (2000)⁵ demonstrated regulation of ATP synthase genes in response to acid stress, a key determinant of enamel demineralization.
2. Xie et al. (2000)¹³ characterized a two-component signaling system influencing transcriptional responses and metabolic adaptation.
3. Wen & Burne (2002)⁵ identified regulatory roles for *cipB* and *cipC* in stress tolerance, with RNA-level signaling influencing survival in acidic environments.
4. Choi et al. (2002)⁶ discovered a LysR-type transcriptional regulator controlling multiple virulence factors, including those associated with biofilm formation.

These studies established the principle that RNA-level gene regulation is essential for microbial adaptation within host tissues, setting the stage for later host-centered discoveries.

5.2. RNA regulation linked to biofilm architecture and species interactions (2006–2013)

Genetic Diversity and Virulence Determinants in *P. gingivalis*. Tribble et al. (2006) showed the distribution of a

virulence gene (*vimA*) varies across *P. gingivalis* strains, demonstrating RNA-level diversity influencing pathogenicity.

Host genetic studies began to highlight RNA-related susceptibility:

1. Oliveira et al. (2011) linked periodontitis and smoking with elevated risk of OSCC, suggesting transcriptional susceptibility in inflamed tissues.
2. Lee et al. (2011) showed IL-1 β gene polymorphisms significantly influence chronic periodontitis severity.
3. Stoecklin-Wasmer et al. (2012). Examined enzyme-modified matrix therapies that modulate host inflammatory responses
4. Scapoli et al. (2015) identified MMP polymorphisms affecting disease severity—MMP expression is strongly RNA-regulated.
5. Mansoori et al. (2014) demonstrated FOXP3 gene polymorphisms affecting regulatory T-cell function and inflammatory RNA signaling.

These studies collectively show that host RNA transcript stability, promoter efficiency, and mRNA expression patterns determine disease susceptibility.

5.3. Transcriptomic studies reveal environmental and nutritional rna modulation (2013–2015)

5.3.1 Nutrient-Dependent Modulation in Oral Streptococci. He et al. (2013)⁷ showed that glucose phosphotransferase systems regulate pyruvate metabolism and fitness via RNA transcriptional shifts.

5.3.2 Host–Pathogen Cross-Talk at the RNA Level

1. Yost et al. (2015) described transcriptomic shifts occurring when *S. mutans* coexists with *Candida albicans*, influencing host inflammatory responses.
2. Wang et al. (2015) demonstrated that periodontal ligament stem cell–conditioned medium alters *P. gingivalis* gene expression, highlighting host-regulated microbial RNA pathways.

5.4. Emergence of host–microbe rna signaling evidence (2016–2020)

This period marks the strongest shift toward host-centered RNA regulation, demonstrating how oral pathogens influence epithelial and immune cells by delivering RNA cargo or triggering host transcriptomic reprogramming.

5.4.1. Host transcriptomic remodeling in response to biofilm pathogens

5.4.1.1. Salivary and epithelial RNA responses

Zhang et al. (2016) showed that salivary microbial profiles in periodontitis and diabetes are associated with altered host inflammatory gene expression. Their findings indicated that host transcriptional dysregulation parallels shift in biofilm composition.

5.4.1.2. Hypervirulent strains and host RNA-mediated immunity

Hong et al. (2017) demonstrated that hypermucoviscous *Klebsiella pneumoniae* strains provoke strong transcriptional immune activation, suggesting RNA-level host recognition pathways that may be shared with periodontal pathogens.

5.4.1.3. Pregnancy outcomes and host transcriptomic burden

He et al. (2018) reported a significant association between periodontitis and adverse pregnancy outcomes. Although not purely mechanistic, the study suggested RNA-mediated inflammatory pathways as drivers of systemic disease.

Together, these findings position host RNA regulation as a determinant of periodontal and systemic disease expression.

5.4.2. Extracellular Vesicle (EV)-mediated RNA transfer from oral pathogens

5.4.2.1. *Streptococcus mutans* EVs alter host gene expression

Two pivotal studies demonstrate the direct transfer of functional RNA cargo:

Liu et al. (2020) showed *S. mutans* EVs deliver bioactive RNA that alters epithelial cell transcriptional profiles, affecting genes regulating immunity, apoptosis, and cytokine pathways.

Wu et al. (2020) further revealed that EVs disrupt epithelial barrier integrity by modulating expression of tight-junction-related mRNAs.

These findings provide direct evidence of cross-kingdom RNA communication, where bacterial RNA modifies host gene expression to facilitate colonization.

5.4.3. Host response to periodontopathogen nutritional conditions (2019–2021)

5.4.3.1. Iron-dependent transcriptomic modulation in *P. gingivalis*

1. Redanz et al. (2019) reported that iron availability influences RNA-driven regulation of biofilm formation and virulence.
2. Fitzpatrick et al. (2020)¹¹ and Bao & Belibasakis (2021)¹⁰ found distinct transcriptional responses under iron depletion and nutrient shifts, showing environmental pressures drive virulence via RNA-level regulatory networks.

These environmental factors affect how pathogens interact with host immune cells and epithelial RNA pathways.

5.4.4. Probiotic Modulation of Host Gene Expression (2013–2019)

Several randomized clinical trials demonstrate probiotics influence host transcriptional responses to dysbiosis:

1. Lee et al. (2013) and Yoshizawa et al. (2013) showed probiotics modify supragingival microbiota and suppress inflammatory cytokine mRNA levels.
2. Baek et al. (2018) and Jang et al. (2019) demonstrated probiotic and recombinant probiotic strains reduce pathogenic biofilms and alter host inflammatory gene transcription.

These studies highlight the role of beneficial microbial RNA signals in rebalancing host immunity.

5.4.5 Host genetic susceptibility and rna-regulated pathways

Key host polymorphism studies reveal the genetic foundation of RNA-mediated immune responses:

1. Lee et al. (2011): IL-1 β gene variants shape cytokine mRNA expression and inflammatory potential.
2. Scapoli et al. (2015) MMP gene variants influence extracellular matrix breakdown through RNA-controlled expression.
3. Mansoori et al. (2014) FOXP3 polymorphisms affect regulatory T-cell RNA expression, weakening host immune control.
4. Oliveira et al. (2011) Chronic inflammation and smoking influence RNA-level susceptibility to OSCC.

Together, these studies show that host RNA pathways determine inflammatory severity and disease progression.

Host-pathogen crosstalk mediated by extracellular vesicles and RNA signals

1. Pathak et al. (2020) reviewed EV roles in cross-talk, showing pathogens manipulate host RNA pathways to evade immunity.
2. Nakanishi et al. (2017) showed heat-killed probiotics modulate host periodontal RNA signaling to suppress inflammation.

This supports the emerging paradigm that oral pathogens communicate with host cells through EV-RNA trafficking, actively manipulating host transcriptional networks.

6. Discussion

The findings of this systematic review demonstrate that RNA-mediated regulatory pathways play a far more extensive role in oral biofilm development and host pathogenic responses than previously recognized. Across the included studies, bacterial small RNAs (sRNAs), extracellular vesicle (EV)-associated RNA transport, host transcriptional responses, and genetic polymorphisms consistently emerged as key factors influencing biofilm stability, virulence expression, and disease susceptibility.

Collectively, these results illustrate that RNA-based communication forms an integrated regulatory network that coordinates microbial behaviour while simultaneously shaping host inflammatory and immune pathways.

A central observation from the reviewed studies is the versatility of bacterial sRNAs in controlling essential virulence functions within biofilms. Multiple investigations reported that sRNAs modulate quorum sensing circuits, stress responses, metabolic adaptation, and the expression of adhesins and proteolytic enzymes essential for biofilm maturation.¹¹ These regulatory effects allow organisms such

as *Streptococcus mutans* and *Porphyromonas gingivalis* to rapidly adjust to environmental changes, enhancing their ability to persist under acidic, oxidative, and nutrient-limited conditions. The dynamic responsiveness of sRNAs also provides bacteria with a rapid regulatory mechanism that operates more efficiently than protein-based transcription factors, especially in the high-density microenvironment’s characteristic of oral biofilms. The major RNA-driven mechanisms influencing oral biofilm development and host pathogenic responses are summarized in **Table 1**.

Table 1: RNA-mediated mechanisms contributing to oral biofilm development and pathogenicity

Mechanism	Primary Source	Type of RNA/Regulator	Key Functional Role	Impact on Host/Biofilm
Stress-response gene regulation	<i>Streptococcus mutans</i>	sRNAs, mRNA transcriptional shifts	Adaptation to acidic & nutrient-limited environments	Enhanced survival, EPS formation, acidogenicity
Iron-dependent RNA modulation	<i>Porphyromonas gingivalis</i>	Global transcriptomic remodeling	Response to iron availability	Upregulation of virulence genes, altered biofilm architecture
Extracellular vesicle (EV) RNA transport	<i>S. mutans</i> , <i>P. gingivalis</i>	EV-packaged RNA cargo	Cross-kingdom communication with host	Modifies cytokine expression, disrupts epithelial barrier, promotes inflammation
Host microRNA (miRNA) modulation	Host epithelial & immune cells	miRNAs	Regulation of innate and adaptive immunity	Controls cytokine levels, barrier repair, inflammation resolution
Gene polymorphism-driven RNA alterations	Host genetics	IL-1β, MMPs, FOXP3, TLR variants	Modulate RNA expression efficiency & stability	Alters susceptibility to periodontitis and biofilm-induced tissue destruction
Multispecies RNA communication	Host-microbe interface	sRNAs, EV-RNA, transcriptomic shifts	Regulates microbial cooperation and host responses	Drives dysbiosis, virulence synergy, and chronic inflammation

Another significant theme identified in the literature is the role of extracellular vesicles as vehicles for interkingdom RNA transfer. Several studies indicated that bacterial EVs deliver regulatory RNAs capable of modulating host epithelial and immune functions, including cytokine expression, inflammasome activation, and epithelial barrier integrity. These EV-mediated interactions enable oral pathogens to influence host gene expression even in the absence of direct bacterial contact. Concurrently, host-derived EVs containing microRNAs (miRNAs) were shown to alter microbial behavior and suppress virulence-associated pathways in certain species. This bidirectional RNA communication underscores a more complex relationship between host and biofilm than a simple response to microbial insult. Instead, both parties participate in an ongoing molecular dialogue that shapes the ecological and pathogenic outcome of biofilm formation.

The reviewed evidence also highlights how host transcriptional programs are deeply influenced by microbial RNA signaling. Several included studies reported that exposure to bacterial sRNAs or EV-packaged RNAs triggers epigenetic changes, activates inflammatory cascades, and upregulates pattern-recognition receptors such as Toll-like receptors (TLRs). Importantly, these effects were not uniform across individuals; genetic polymorphisms in immune-regulatory genes, such as FOXP3 and TLR2, were associated with exaggerated inflammatory responses and more severe periodontal destruction. These findings suggest that RNA-mediated mechanisms may help explain interindividual variability in disease progression, providing insight into why some patients develop aggressive forms of periodontal disease despite similar microbial exposures. Key host polymorphisms affecting RNA-regulated immune pathways and periodontal susceptibility are listed in **Table 2**.

Table 2: Host genetic polymorphisms in RNA-Regulated immune pathways associated with biofilm-related disease susceptibility

Gene	Type of Polymorphism	RNA-Level Effect	Functional Consequence	Clinical Relevance
IL-1β	Promoter/SNP variants	Increased IL-1β mRNA expression	Amplified pro-inflammatory response	Severe chronic periodontitis; rapid tissue breakdown
MMP-2 / MMP-9	Promoter, coding-region variants	Enhanced transcription of matrix-degrading enzymes	Accelerated collagen degradation	Greater periodontal attachment loss
FOXP3	Regulatory SNPs	Reduced T-regulatory cell RNA expression	Impaired immune tolerance & heightened inflammation	Higher severity in periodontitis & peri-implantitis
TLR2, TLR4	Pattern-recognition receptor SNPs	Altered downstream mRNA signaling	Dysregulated innate immune activation	Variable host susceptibility to dysbiosis
IL-6	Promoter polymorphisms	Elevated IL-6 transcript levels	Sustained inflammatory signaling	Increased periodontal disease progression

Table 3: Integrated summary of host and microbial rna pathways governing oral biofilm pathogenicity

Level	Key RNA Components	Primary Functions	Pathogenic Outcomes
Microbial RNA Regulation	sRNAs, antisense RNAs, nutrient/iron-responsive transcripts	Stress adaptation, quorum sensing, virulence gene control	Stable, resilient biofilm; enhanced pathogenicity
Extracellular Vesicle-Mediated RNA Transfer	EV-packaged RNA cargo	Host-cell reprogramming, immune modulation	Barrier disruption, cytokine dysregulation
Host RNA Response	miRNAs, cytokine mRNAs, inflammasome-associated RNAs	Immune activation, epithelial repair, inflammatory amplification	Tissue destruction or protection depending on balance
Genetic Susceptibility (RNA-linked)	IL-1β, MMP, FOXP3, TLR polymorphisms	Regulate RNA transcription & stability	Inter-individual risk variation for periodontal disease

The collective evidence supports the notion that RNA-mediated interactions significantly enhance the adaptability and pathogenicity of oral biofilms. However, the mechanisms by which these pathways intersect remain incompletely understood. Most included studies focused on isolated components—such as specific sRNAs or selected host miRNAs—rather than examining how these molecules interact within the broader regulatory network. The fragmented nature of the existing literature limits the ability to construct a fully integrated model of RNA-based communication within the oral cavity. Moreover, differences in experimental designs, sequencing platforms, sample types, and analytical thresholds contributed to variability across studies, making direct comparisons challenging. Standardizing methodological approaches would allow clearer interpretation of how specific RNA molecules influence host–microbe dynamics. An integrated overview of microbial, host, and EV-mediated RNA pathways driving oral biofilm pathogenicity is provided in **Table 3**.

Despite these limitations, the translational implications of RNA-mediated regulation are significant. A growing number of studies identified unique bacterial sRNAs and salivary miRNAs that could serve as early, non-invasive biomarkers for oral potentially malignant disorders (OPMDs) and oral squamous cell carcinoma (OSCC).^{6,7} The stability of

RNA molecules in saliva—especially when encapsulated within EVs—makes them promising candidates for clinical diagnostics. Additionally, RNA-based therapeutics, such as antisense oligonucleotides, RNA interference, and miRNA mimics, hold potential for selectively modulating pathogenic pathways within biofilms. For instance, synthetic RNA inhibitors targeting quorum-sensing sRNAs have demonstrated the ability to disrupt biofilm formation and reduce virulence factor expression in vitro. Similarly, delivery of anti-inflammatory miRNAs could represent a novel strategy for mitigating host tissue damage during chronic periodontal inflammation.

It is also notable that several studies reported the presence of distinct RNA signatures that differ between healthy individuals, patients with chronic periodontitis, and those with OPMDs. These signatures not only reflect microbial composition but also host immune activation, oxidative stress, and epithelial transformation. Integrating RNA-based biomarkers with clinical parameters may enhance early detection of pathological changes that are not yet clinically apparent, improving patient outcomes and reducing the progression of precancerous lesions.

Nevertheless, much remains to be explored. The majority of included studies were observational or

exploratory in nature, and few utilized longitudinal designs. As a result, the temporal sequence of RNA changes during disease progression remains unclear. Whether RNA dysregulation is a cause or a consequence of biofilm pathogenicity cannot be definitively determined from the existing literature. Additionally, the influence of external factors—such as diet, smoking, oral hygiene practices, and systemic health—on RNA expression was not consistently addressed. These variables may significantly modify RNA profiles and should be incorporated into future research.

Future studies should aim to adopt integrated multi-omics approaches combining transcriptomics, proteomics, metabolomics, and microbial community profiling. Such comprehensive analysis would enable a more accurate representation of how RNA-mediated pathways interface with biochemical and microbial processes in the oral environment. Furthermore, experimental models capable of replicating the complex, multispecies structure of oral biofilms are needed to validate RNA-based interactions identified through sequencing.

7. Conclusion

This systematic review demonstrates that RNA-associated regulatory pathways constitute a foundational mechanism in the host response to oral biofilms. Although canonical RNA interference is absent in bacteria, both pathogens and host tissues deploy diverse RNA-centered strategies to modulate colonization, immune activation, and disease progression.

Pathogenic species such as *Streptococcus mutans* and *Porphyromonas gingivalis* release extracellular vesicles (EVs) enriched with functional RNA cargo that directly alters epithelial transcriptional programs. These EV-RNA interactions impair barrier integrity, amplify inflammatory cascades, and enhance pathogen survival. Simultaneously, the host responds through extensive RNA-level remodeling, activating cytokine and chemokine transcripts, stress pathways, inflammasome components, and immune-defense gene networks.

Transcriptomic studies reveal that environmental pressures—nutrient deprivation, iron limitation, dysbiosis—reconfigure microbial RNA expression in ways that shape virulence expression. Similarly, host genetic polymorphisms in RNA-regulated inflammatory genes (IL-1 β , MMPs, FOXP3) govern susceptibility to biofilm-associated disease.

Collectively, evidence indicates that oral biofilm pathogenicity is not driven solely by microbial factors but by a dynamic cross-kingdom dialogue mediated through RNA. Understanding these multilevel RNA pathways enhances our ability to interpret disease mechanisms, identify biomarkers, and develop targeted RNA-based therapeutic strategies for periodontal and peri-implant infections.

Future research should prioritize standardized transcriptomic platforms, functional EV-RNA validation,

and host–pathogen co-transcriptomic studies to translate these mechanistic insights into precision clinical applications.

Key findings on RNA-Mediated Mechanisms Influencing Host Susceptibility

7.1. Extracellular vesicle (EV)-Mediated cross-kingdom rna transfer

Pathogenic bacteria, such as *Streptococcus mutans* and *Porphyromonas gingivalis*, actively influence host cells by releasing Extracellular Vesicles (EVs) containing functional RNA cargo.

1. Mechanism of Action: *S. mutans* EVs deliver bioactive RNA that is internalized by host epithelial cells.
2. Host Effects: This delivered RNA alters host transcriptional profiles, specifically affecting:
 - a. Genes regulating immunity and apoptosis.
 - b. Cytokine pathways.
 - c. Epithelial barrier integrity by modulating the expression of tight-junction–related mRNAs.
3. Outcome: This cross-kingdom RNA communication facilitates colonization and enhances pathogen survival by disrupting the host's physical and immune defenses.

7.2. Host transcriptomic remodeling

The host's own gene expression (transcriptome) undergoes significant and rapid changes (remodeling) when exposed to pathogenic biofilms.

1. Trigger: Exposure to microbial challenges (pathogens, sRNAs, or EV-packaged RNAs).
2. Host Response: Host cells (e.g., gingival epithelial cells, immune cells) respond via:
 - a. Rapid transcriptional modulation.
 - b. Upregulation of cytokine mRNA.
 - c. Activation of inflammasome-associated RNA signaling.
 - d. Changes in salivary and epithelial RNA signatures that parallel shifts in biofilm composition and inflammatory gene expression.
3. Outcome: These host RNA responses determine whether biofilm colonization remains commensal or progresses to destructive periodontal disease.

7.3. Host genetic polymorphisms in RNA-regulated genes

Individual susceptibility to biofilm-associated disease is governed by genetic variations (polymorphisms) in key immune-regulatory genes, many of which affect RNA transcription or stability.

Key Polymorphisms Identified:

1. IL-1 β gene variants: Significantly influence cytokine mRNA expression and chronic periodontitis severity.

2. MMP gene variants: Affect extracellular matrix breakdown through RNA-controlled expression.
3. FOXP3 polymorphisms: Affect regulatory T-cell RNA expression, weakening host immune control and contributing to more severe periodontal destruction.

Outcome: These variations in RNA-related genes modulate the inflammatory profile and determine disease susceptibility and severity.

8. Source of Funding

None.

9. Conflict of Interest

None.

References

1. Fire A, Xu S, Montgomery MK, Kostas SA, Driver SE, Mello CC. Potent and specific genetic interference by double-stranded RNA in *Caenorhabditis elegans*. *Nature*. 1998;391(6669):806–11. <https://doi.org/10.1038/35888>
2. Albrecht M, Froberg C, Friess H, Löffler B, Mäder U, Peschel A, et al. DNA microarray analysis of *Streptococcus mutans* biofilms. *J Bacteriol*. 2006;188(23):8368–77. <https://doi.org/10.1186/1471-2180-8-236>
3. Redanz S, Cheng X, Li Z, Waller T, Merritt J, Kreth J. *Streptococcus mutans* competence induces biofilm formation via regulation of extracellular DNA release. *Mol Oral Microbiol*. 2012;27(3):194–205. <https://doi.org/10.1128/JB.01493-14>
4. Lemos JA, Quivey RG Jr, Koo H, Abranches J. Stress responses of *Streptococcus mutans* and their influence on virulence. *Microbiol Mol Biol Rev*. 2013;77(3):757–79. <https://doi.org/10.1007/s12275-015-5432-6>
5. Liu C, Nascimento M, Burne RA. Environmental influences on *Streptococcus mutans* biofilm development. *FEMS Microbiol Lett*. 2012;326(1):13–9. https://doi.org/10.1007/978-3-540-75418-3_3
6. Kuboniwa M, Tribble GD, James CE, Kilic AO, Tao L, Herzberg MC, et al. *Porphyromonas gingivalis* adapts to the epithelial environment by modulating the host transcriptome. *Cell Microbiol*. 2013;15(8):1259–73. <https://doi.org/10.1080/20002297.2020.1801090>
7. Abranches J, Zeng L, Kajfasz JK, Palmer SR, Chakraborty B, Wen ZT, et al. Biology of biofilm formation: role of regulatory RNA. *Mol Oral Microbiol*. 2014;29(4):202–16
8. Del Pozo JL, Patel R. The challenge of treating biofilm-associated bacterial infections. *Clin Pharmacol Ther*. 2007;82(2):204–9. <https://doi.org/10.1038/sj.clpt.6100247>
9. Lee JK, Kim YS, Chung J, Choi EY, Park SH. Probiotic effect on inflammatory markers in gingivitis. *J Periodontol Res*. 2013;48(4):584–93. <https://doi.org/10.1038/ejcn.2011.45>
10. Bao K, Belibasakis GN. Transcriptomic response of *P. gingivalis* to nutrient stress. *Virulence*. 2021;12(1):555–66. <https://doi.org/10.1111/jre.13353>
11. Fitzpatrick R, Garcia R, Jaslow D, Richardson J, Bostanci N. Iron modulation reshapes *P. gingivalis* virulence. *J Oral Microbiol*. 2020;12(1):1829444. <https://doi.org/10.1016/j.femsre.2004.09.001>
12. Hong SS, Jeon J, Kim J, et al. Host immune transcriptional response to hypervirulent *Klebsiella pneumoniae*. *Infect Immun*. 2017;85(8):e00261–17.
13. Zhang S, Sun X, Wang J. Microbial–host RNA signaling in oral diseases: transcriptomic insights. *Oral Dis*. 2018;24(5):749–59. <https://doi.org/10.1128/AEM.01782-15>

Cite this article: Asokan JP. RNA interference and its regulatory role in oral biofilm formation and pathogenicity. *J Advanc Oral Health*. 2025;2(2):47-54.



Original Research Article

Perception of oral and maxillofacial surgeons toward perioperative nutritional care: A KAP study

Bhoomi Somani¹, Lakshmi Rathan AC^{2*}, Sapna DP Somani³, Charmi Somani⁴

¹Tata Institute of Social Sciences, Mumbai, Maharashtra, India.

²Department of Oral and Maxillofacial Surgery, SRM Kattankulathur Dental College and Hospital, SRM Institute of Science and Technology, SRM Nagar, Kattankulathur, Kancheepuram, Chennai, Tamil Nadu, India.

³Fellow in Head and neck Surgical Oncology HCG ICS Khubchandani Hospital, Colaba, Mumbai, Maharashtra, India.

⁴Consultant Dietitian (Freelancing) Foods, Nutrition and Dietetics, Dombivli, Thane, Maharashtra, India.

Abstract

Introduction: To date, no data exist on the KAP of OFMS surgeons regarding postoperative nutritional care. The current prospective study aimed to identify nutritional knowledge, attitudes and practices of surgeons that can further benefit patients combating malnutrition.

Aim and Objective: Nutrition is an important factor in deciding the time taken to heal perioperative wounds. OMFS combines medicine and dentistry, extending beyond oral surgery to craniomaxillofacial surgery. Patients undergoing surgery related to nasal, oral and mental regions have even less access or a lower chance of meeting their daily nutritional requirements because of difficulty in chewing, swallowing or gulping, making it difficult for patients to recover quickly. Therefore, it becomes important for surgeons to have some nutritional knowledge, or they should actively refer patients to clinical dietitians for rapid recovery.

Materials and Methods: Data were collected via a questionnaire with 10 questions on KAP that was circulated online.

Results: Under the knowledge section, for 7 questions, fewer than 50% of the participants provided correct answers. The average level of knowledge was 43.4%, and the average level of attitude was 69.7%.

Conclusion: In conclusion, this study suggests that OMFS surgeons (trainees and practitioners) should have some nutritional knowledge to treat perioperative patients in an enhanced manner.

Keywords: Nutritional care, OMFS, Malnutrition, Surgery, Postoperative patient

Received: 25-07-2025; **Accepted:** 22-12-2025; **Available Online:** 05-01-2026

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1. Introduction

The science of nutrition involves understanding how the body uses food to meet its needs for growth, development, repair, and maintenance.¹ When the body does not receive enough vitamins, minerals, and other nutrients necessary to maintain healthy tissues and organ functions, malnutrition results.² To sustain life, cells must receive enough vitamins, minerals, fibre, water, carbohydrates, proteins, lipids, and micronutrients.³ Certain dietary deficiencies can affect the wound healing time and perioperative course. For example, ascorbic acid is required to synthesize collagen; hence, vitamin C deficiency can cause new wounds to heal more slowly or heal scars to lose strength.⁴

OMFS combines medicine and dentistry, extending beyond oral surgery to craniomaxillofacial surgery. The care of severe facial trauma, craniofacial deformity, oral oncology, temporomandibular disorders, facial anaesthetics, and treatment of oral diseases are all included in the field of maxillofacial surgery in India.⁵ Because it incorporates both highly specialized surgical principles and the concepts of dental surgery, this branch of medicine has always been distinctly unique in its emergence.⁶ Most procedures involve the oral cavity and alter its harmony. This, in turn, largely affects the general intake of nutrition by patients. Two-thirds of patients lose weight while hospitalized, and up to 40% of patients are undernourished when they are admitted.⁷

*Corresponding author: Lakshmi Rathan AC
Email: lakshmir5@srmist.edu.in

Before the operative procedure, a skilled oral surgeon should be able to evaluate the patient's nutritional state and requirements. They should also be aware of the many nutritional support modalities and be able to recommend them for the patient's best interests.⁸ However, there is a knowledge gap among the OMFS regarding the perioperative nutritional care of patients undergoing surgery. There are no studies in the literature that have evaluated the perception of the OMFS regarding preoperative nutritional care. Hence, the purpose of this study was to evaluate the perioperative nutritional knowledge, attitudes and practices of OMFS practitioners and trainees.

2. Materials and Methods

A prospective purposive study was conducted for a period of 1 year from Jan 2023 to Jan 2024 among OMFS practitioners and OMFS trainees from all over the country. A well-structured questionnaire was adopted from a previous study⁹ designed to assess the knowledge, attitudes, and practices of participants regarding nutritional care among perioperative patients. Before circulation, this questionnaire was evaluated by two experts each from the field of OMFS and nutrition and dietetics. The content validity ratio was calculated to assess the validity of the questionnaire, which was found to be 0.73.

The participants who took part in the study voluntarily completed a questionnaire containing 30 validated closed-ended questions. The questionnaires were circulated and administered through Google Forms. Assessment of the content was performed by recording the responses of all the participants. The questionnaire consisted of 4 sections. The first section included questions related to sociodemographic details, and the second, third and fourth sections included questions related to knowledge, attitudes and practices, respectively, of the OMFS for nutritional care in perioperative patients.

The collected data for KAP were computed, and the results were obtained via SPSS software version 25. For knowledge, each correct answer was marked as one, and each incorrect answer was marked as zero. The total knowledge score was calculated by adding marks for all correct answers, and the percentage was calculated out of 10. For attitudes, for negative sentences, strongly agree was given a score of 1, agree was given a score of 2, disagree was given a score of 3, and strongly disagree was given a score of 4. Reverse coding was used for positive sentences. The total attitude score was calculated by summing the scores obtained for each sentence, and the percentage was calculated out of 40. The data are presented as the means $\pm$ SDs or frequencies (percentages). Cross tabulations were computed and compared via Fisher's exact test or the chi-square test. The Mann-Whitney U test was used to calculate the difference in individual attitude sentences between trainees and practitioners. The independent sample test was used to calculate the difference in percentage knowledge and percentage attitudes between trainees and practitioners.

Clinical trial registry - NA

3. Results

3.1. Statistical methods

The mean age of the study participants was 28.7 ± 6.5 years. There was no major difference in the percentage of males and females enrolled in the study. The maximum number of participants were from southern India. Among the trainees, higher percentages were from the second year or third year than from the first year, and most practitioners had 1–5 years of experience. Table 1 shows that more than 50% of the participants reported that nutrition was not a part of their training.

Knowledge - Table 2 shows that for the 10 questions, for two questions, more than 75% of the participants gave the correct answer; for one question, approximately 52.4% gave the correct answer; and for the remaining seven questions, fewer than 50% gave correct answers. A significantly greater percentage of practitioners gave a correct answer for the enteral route, which is the safest route to feed postoperative patients who have prolonged intensive care unit (ICU) care. In the case of long-standing postoperative feed, PEG feeds are the most ideal form of feeding, with the central line being the most ideal route to administer parenteral nutrition and the Harris-Benedict equation being used to assess caloric requirements compared with those of trainees ($p < 0.05$). No other significant differences were observed.

Attitude - Table 3 shows that, from the five negative statements, the best attitude was for postoperative care of a patient, which can be managed without a dietician, with 74.7% of the participants reporting that they strongly disagreed. According to the positive statements, the best attitude was that nutrition plays an important role in the management of various diseases, with 99% of the participants reporting strongly disagree.

Table 4 shows that trainees had better attitudes for “you have enough knowledge regarding postoperative nutrition”, “the enteral route mimics normal physiologic function” and “the route of administration determines individual response to injury” than practitioners did, as they had higher average scores ($p < 0.05$). On the other hand, practitioners had a better attitude toward obtaining dietary counselling for patients undergoing surgery than trainees did ($p < 0.05$).

Marks obtained for knowledge and attitudes - The average level of knowledge was 43.4%, and the average level of attitudes was 69.7%. Compared with trainees, practitioners had significantly greater knowledge ($p < 0.05$). No significant differences were observed in the attitudes of the trainees and practitioners ($p > 0.05$) (**Figure 1**).

Table 5 shows that practices related to the nutrition care process were significantly different between trainees and practitioners in terms of the proportion of patients for whom

nutritional assessment was undertaken, the frequency of weighing patients on admission, the reason for weighing patients, the protocol followed when patients with prolonged ICU stays had abnormal routine values and the frequency of conducting a protein analysis test on postoperative patients ($p < 0.05$). Compared with practitioners, a greater percentage of trainees reported that they conducted nutritional assessments on all patients and weighed patients to calculate anaesthesia. On the other hand, a greater percentage of practitioners reported that they always weighed patients on admission, consulted a dietitian if values were above routine values or conducted protein analysis on patients once a week than did trainees.

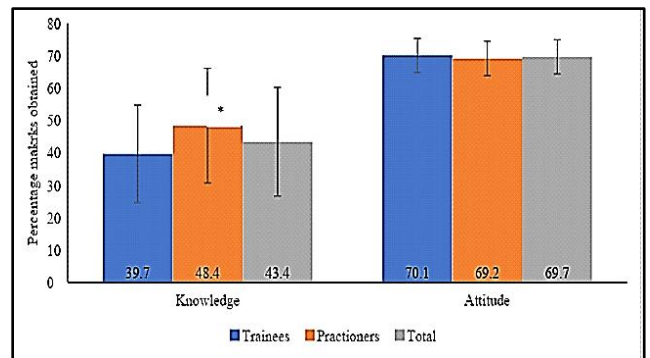


Figure 1: Total knowledge and attitudes percentage obtained

Table 1: Demographic data

	Frequency	Percentage
Gender		
Females	96	46.6
Males	110	53.4
Zone in India		
Eastern	12	5.8
Western	40	19.4
Northern	22	10.7
Southern	120	58.3
Central	12	5.8
Are you a		
Trainee	118	57.3
Practitioner	88	42.7
If Trainee, which year are you in?		
First year	24	
Second year	40	
Third year	54	
If practitioner, years of experience		
1 – 5 years	66	75
6 – 10 years	8	9.1
>10 years	14	15.9
Nutrition a part of training program		
Yes	68	33
No	116	56.3
Not sure	22	10.7

Table 2: Knowledge of nutrition care for postoperative patients

	Trainee s (n=118)		Practitioner rs (n=88)		Total (n=206)		P- value
	N	%	N	%	N	%	P-value
1g of protein + 1 g of carbohydrate + 1 g of fat provides 17 kcals	38	32.2	40	45.5	78	37.9	0.052
Immune nutrients in diet increase cellular defense, lower systemic inflammation and curb free radicals	98	83.1	70	79.5	168	81.6	0.587
Serum albumin is the most important biomarker to assess nutritional status	86	72.9	70	79.5	156	75.7	0.325
The normal range for serum albumin is 3.4 to 5.4 g/dl	52	44.1	48	54.5	100	48.5	0.159
Both standardized commercial sachets and blenderized home cooked meals are equally	42	35.6	38	43.2	80	38.8	0.312

helpful							
TLC and BMI can be used to assess immune competence	66	55.9	42	47.7	108	52.4	0262
The enteral route is the safest route to feed postoperative patients who have prolonged ICU care	6	5.1	14	15.9	20	9.7	0.016
In case of long standing post-Operative feed, Percutaneous Endoscopic Gastrostomy feeds are the most ideal form of feeding	20	16.9	26	29.5	46	22.3	0.042
Central line is the most ideal route for administering total parenteral nutrition	16	13.6	30	34.1	46	22.3	0.001
Harris Benedict equation is used to assess calorie requirement	44	37.3	48	54.5	92	44.7	0.016

Table 3: Attitudes towards the nutritional care process for postoperative patients

	N	%	N	%	N	%	N	%
Negative sentences								
	Strongly agree		Agree		Disagree		Strongly disagree	
Oral and Maxillofacial Surgeons are very knowledgeable in nutritional matter.	18	8.7	94	45.6	80	38.8	14	6.8
You have enough knowledge regarding Postoperative nutrition.	10	4.9	92	44.7	86	41.7	18	8.7
Postoperative care of a patient can be managed without a dietician.	14	6.8	38	18.4	136	66	18	8.7
It is doctor's responsibility to assess the nutritional status of the patient.	88	42.7	112	54.4	6	2.9	-	-
Appropriate and adequate nutritional support is normally provided in the surgical ward.	34	16.5	102	49.5	68	33	2	1.0
Positive sentences								
	Strongly disagree		Disagree		Agree		Strongly agree	
It is mandatory to get dietary counselling for patient undergoing surgery.	-	-	24	11.7	116	56.3	66	32
It is important to assess the nutritional status of every patient admitted to the ward.	-	-	14	6.8	100	48.5	92	44.7
Nutrition has an important role in management of various diseases.	-	-	2	1.0	82	39.8	122	59.2
Enteral route mimic normal physiologic function.	-	-	32	15.5	140	68	34	16.5
Route of administration determines individual response to injury.	2	1.0	18	8.7	126	61.2	60	29.1

Table 4: Attitudes towards the nutritional care process for postoperative patients compared between trainees and practitioners

Data are presented as the mean±SD.

	Trainees (n=118)	Practitioners (n=88)	P- value
Negative Sentences			
Oral and Maxillofacial Surgeons are very knowledgeable in nutritional matter.	2.4±0.7	2.6±0.8	0.153
You have enough knowledge regarding postoperative nutrition.	2.6±0.7	2.4±0.7	0.033
Postoperative care of a patient can be managed without a dietician.	2.7±0.7	2.9±0.7	0.105
It is doctor's responsibility to assess the nutritional status of the patient.	1.6±0.6	1.6±0.5	0.983
Appropriate and adequate nutritional support is normally provided in the surgical ward.	2.2±0.7	2.2±0.7	0.570
Positive sentences			
It is mandatory to get dietary counselling for patient undergoing surgery.	3.1±0.6	3.3±0.6	0.021
It is important to assess the nutritional status of every patient admitted to the ward.	3.4±0.6	3.3±0.7	0.349

Nutrition has an important role in management of various diseases.	3.6±0.5	3.6±0.5	0.947
Enteral route mimic normal physiologic function.	3.1±0.5	2.8±0.6	0.001
Route of administration determines individual response to injury.	3.4±0.5	3.0±0.6	0.001

Table 5: Practice of the nutritional care process for postoperative patients

	Trainee s (n=118)		Practitioners (n=88)		Total (n=206)		P-value
	N	%	N	%	N	%	P-value
Criteria used to assess nutritional status							
Height, weight and body mass index	64	57.1	52	59.1	11	58.0	0.161
Diet history	26	23.2	12	13.6	38	19	
Protein analysis	22	19.6	24	27.3	46	23	
Proportion of patients on which nutritional assessment is undertaken							
All	38	32.2	20	22.7	58	28.2	0.005
Some patients	24	20.3	36	40.9	60	29.1	
Critical care patients	52	44.1	32	36.4	84	40.8	
None	4	3.4	0	0	4	1.9	
Frequency of Weighting patients on admission							
Never	4	3.4	2	2.3	6	2.9	0.002
Rarely	22	18.6	2	2.3	24	11.7	
Occasionally	36	30.5	26	29.5	62	30.1	
Always	56	47.5	58	65.9	114	55.3	
Reason to weigh patient							
To calculate anaesthesia dose	84	71.2	44	50	128	62.1	0.001
For medical records	30	25.4	30	34.1	60	29.1	
For malnourished patients	4	3.4	14	15.9	18	8.7	
Frequency of discussing nutritional status and nutritional management of patients during ward rounds							
Pertaining to patients	18	15.3	12	13.6	30	14.6	0.886
Sometimes	60	50.8	48	54.5	108	52.4	
Always	40	33.9	28	31.8	68	33.0	
Protocol followed when patients in prolonged ICU stay having abnormal routine values							
Consult dietitian	18	15.3	20	22.7	38	18.4	0.043
Refer to a physician	22	18.6	6	6.8	28	13.6	
Discuss diet options	6	5.1	2	2.3	8	3.9	
All of the above	72	61.0	60	68.2	132	64.1	
Consider conducting a protein analysis test on postoperative patients							
Yes	52	44.1	32	36.4	84	40.8	0.370
No	16	13.6	10	11.4	26	12.6	
May be	50	42.4	46	52.3	96	46.6	
Frequency of conducting a protein analysis test on postoperative patients							
Once/week	44	37.3	44	50	88	42.7	0.003
Once/month	40	33.9	18	20.5	58	28.2	
Once/six months	18	15.3	4	4.5	22	10.7	
Never	16	13.6	22	25	38	18.4	
Method to assess the position of naso-gastric tube							
Clinically (epigastrium)	44	37.3	24	27.3	68	33	0.258
Radiological assessment	12	10.2	6	6.8	18	8.7	
Both	56	47.5	54	61.4	110	53.4	
None	6	5.1	4	4.5	10	4.9	
Frequently suggested nutritional supplement							
Multivitamin	60	50.8	36	40.6	96	46.6	0.333
Protein	52	44.1	46	52.3	98	47.6	
Omega-3	4	3.4	2	2.3	6	2.9	
None of the above	2	1.7	4	4.5	6	2.9	

4. Discussion

Nutritional status is recognized as an essential component of surgical recovery regimens. OMFS, while crucial for treating various conditions in the jaw, mouth, and neck regions, often necessitates limitations on postoperative food intake. This restricted diet can negatively impact patients' health by hindering their ability to absorb essential nutrients, potentially leading to malnutrition. To treat the postoperative stress response and minimize the loss of muscle mass, strength, and functionality, adequate nutritional intake is necessary.¹⁰ A nutritional deficiency should be treated with a balanced diet and dietary supplementation of the deficient nutrient before surgery.¹¹ Early dietary intake after surgery not only guarantees a shorter hospital stay but also helps patients maintain their body composition.¹² A study by Brown, T., Edwards, A., et al. concluded that early identification and management of malnutrition is necessary to minimize the risk of postoperative complications and reduce the length of stay and should be considered a key component of rehabilitation programs.¹³

The Likert scale was used to assess the attitudes of participants; although 74.7% of participants disagreed that dietitians are unnecessary for perioperative care, this study suggests a positive attitude toward the role of nutritional management in improving recovery and potentially reducing hospital stays.¹²

In the present study, 15.5% of practitioners correctly identified the enteral route as the safest feeding method for perioperative patients requiring extended intensive care unit (ICU) care. A study conducted by Seron-Arbeloa, C., Zamora-Elson, M., et al. reported that enteral nutrition is preferable to parenteral nutrition because it is less expensive and generally results in better patient outcomes—including fewer infections and shorter hospital stays.¹⁴ A total of 29.5% of surgeons identified PEG as the ideal feeding method for long-term postoperative needs, which aligns with the literature published by Rahnemai-Azar, A. A., Rahnemai-Azar, A. A, etc., suggesting that PEG is the preferred route because of its superior access to surgical methods.¹⁵

Moreover, 22.3% of surgeons (trainees and practitioners) believed the central line to be the most suitable route for PN administration; this approach may not be optimal. Research conducted by Berlana, D. (2022) emphasized the use of central lines due to the hypertonicity of PN solutions, but alternative routes can be explored to minimize catheter-related complications.¹⁶

The best attitude was that nutrition has an important role in the management of various diseases, with 99% of participants reporting strongly disagree, which was further supported by another study published by Gropper, S. S. (2023). Nutrition is often considered a lifestyle factor that

leads to the prevention of many chronic diseases, including obesity, cardiovascular disease, hypertension, stroke, type 2 diabetes, metabolic syndrome, some cancers, and, seldom, some neurological diseases.¹⁷

Our results revealed interesting differences in knowledge and attitudes between OMFS trainees and practitioners. The trainees had a more positive attitude toward their knowledge of perioperative nutrition ($p < 0.05$) and toward the enteral route, which mimics normal physiological function ($p < 0.05$). Furthermore, the trainees also believed that the route of administration influences individual responses to injury ($p < 0.05$). On the other hand, practitioners strongly believed in the necessity of dietary counselling for surgical patients ($p < 0.05$). Practitioners presented significantly higher knowledge scores than did trainees ($p < 0.05$). Interestingly, no significant differences in overall attitudes were detected between the two groups ($p > 0.05$).

Practices related to the nutritional care process were significantly different between trainees and practitioners for several patients for whom nutritional assessment was undertaken, for whom the weight of patients on admission was measured, for whom the patients were weighed, for whom the protocol followed when patients with prolonged ICU stays had abnormal routine values and for whom a protein analysis test was frequently conducted on perioperative patients ($p < 0.05$). A total of 32.2% of the trainees conducted nutritional assessments on all patients. On the other hand, 65.9% of practitioners reported that they always weighed patients on admission, and compared with trainees, 50% of practitioners conducted protein analysis on patients once a week.

This study has potential limitations, one of which is that it is an observational KAP study. Owing to resource constraints, the study was conducted with a limited number of participants. To our knowledge, this study is the first to investigate the importance of the KAP of the OMFS regarding perioperative nutrition, even though there are multiple studies on the use of the OMFS to evaluate the impact of nutrition on patients with oral injury and their quality of life, and there is no strong evidence suggesting that their KAP is related to perioperative care.

5. Conclusion

In conclusion, this study suggests that OMFS surgeons (trainees and practitioners) should have some nutritional knowledge to treat perioperative patients in an enhanced manner. Limited nutritional knowledge among OMFS may necessitate referrals to registered dietitians in the pre- and postoperative phases, potentially leading to shorter hospital stays and improved patient recovery. This approach could promote a more holistic model of patient care management.

6. List of Abbreviations

1. OMFS - Oral and maxillofacial surgery
2. PEG - Percutaneous endoscopic gastrostomy
3. PN - Parenteral Nutrition
4. KAP - Knowledge, attitudes and practices

7. Source of Funding

None.

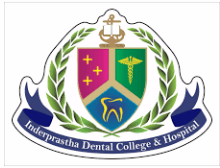
8. Conflict of Interest

None.

References

1. Jain S, Jain A, Palekar U, Shigli K, Pillai A, Pathak AD. Nutritional considerations for patients undergoing maxillofacial surgery—A literature review. *Indian J Dent.* 2014;5:52-5. <https://doi.org/10.1016/j.ijd.2013.07.014>.
2. Sheetal A, Hiremath VK, Patil AG, Sajjanetty S, Kumar SR. Malnutrition and its oral outcome—a review. *J Clin Diagn Res.* 2013;7(1):178-80. <https://doi.org/10.7860/JCDR/2012/5104.2702>.
3. Gondivkar SM, Gadgil AR, Gondivkar RS, Sarode SC, Sarode GS, Patil S, et al. Nutrition and oral health. *Dis Mon.* 2019;65(6):147-54. <https://doi.org/10.1016/j.disamonth.2018.09.009>.
4. Falender LG, Leban SG, Williams FA. Postoperative nutritional support in oral and maxillofacial surgery. *J Oral Maxillofac Surg.* 1987;45(4):324-30. [https://doi.org/10.1016/0278-2391\(87\)90353-3](https://doi.org/10.1016/0278-2391(87)90353-3).
5. Mohanty R, Singh V. An analysis of approach toward oral and maxillofacial surgery: a survey of 1800 health-care specialists, students, and general people in Odisha, India. *Natl J Maxillofac Surg.* 2019;10(1):68-72. https://doi.org/10.4103/njms.NJMS_76_18.
6. Singh N, Ahluwalia PK. Maxillofacial Surgery in Corporate Hospital Setup. *J Maxillofac Oral Surg.* 2018;17(3):267-9. <https://doi.org/10.1007/s12663-018-1112-5>.
7. Awad S, Herrod PJ, Forbes E, Lobo DN. Knowledge and attitudes of surgical trainees toward nutritional support: food for thought. *Clin Nutr.* 2010;29(2):243-8. <https://doi.org/10.1016/j.clnu.2009.08.016>.
8. Giridhar VU. Role of nutrition in oral and maxillofacial surgery patients. *Natl J Maxillofac Surg.* 2016;7(1):3-9. <https://doi.org/10.4103/0975-5950.196146>.
9. Kobe JA. Aspects of nutritional knowledge, attitudes and practices of nurses working at the surgical division at the Kenyatta National Hospital, Kenya dissertation. Stellenbosch: University of Stellenbosch.
10. Hirsch KR, Wolfe RR, Ferrando AA. Pre and postsurgical nutrition for preservation of muscle mass, strength, and functionality following orthopedic surgery. *Nutrients.* 2021;13(5):1675. <https://doi.org/10.3390/nu13051675>.
11. Chidyllo SA, Chidyllo R. Nutritional evaluation prior to oral and maxillofacial surgery. *N Y State Dent J.* 1989;55(8):38-40.
12. Ho CY, Ibrahim Z, Abu Zaid Z, Mat Daud ZA, Mohd Yusop NB, Mohd Abas MN, et al. Postoperative dietary intake achievement: a secondary analysis of a randomized controlled trial. *Nutrients.* 2022;14(1):222. <https://doi.org/10.3390/nu14010222>.
13. Brown T, Edwards A, Pashley A, Lehn B, Vasani S, Hodge R, et al. Nutritional status and postoperative complications in patients undergoing surgery for advanced pharyngeal or laryngeal cancer. *Eur Arch Otorhinolaryngol.* 2023;280(12):5531-8. <https://doi.org/10.1007/s00405-023-08139-x>.
14. Seron-Arbeloa C, Zamora-Elson M, Labarta-Monzon L, Mallor-Bonet T. Enteral nutrition in critical care. *J Clin Med Res.* 2013;5(1):1. <https://doi.org/10.4021/jocmr1210w>.
15. Rahnama-Azar AA, Rahnamaiazar AA, Naghshizadian R, Kurtz A, Farkas DT. Percutaneous endoscopic gastrostomy: indications, technique, complications and management. *World J Gastroenterol.* 2014;20(24):7739.
16. Berlana D. Parenteral nutrition overview. *Nutrients.* 2022;14(21):4480.
17. Gropper SS. The role of nutrition in chronic disease. *Nutrients.* 2023;15(3):664.

Cite this article: Somani B, Lakshmi Rathan AC, Sapna DP S, Somani C. Perception of oral and maxillofacial surgeons toward perioperative nutritional care: A KAP study. *J Advanc Oral Health.* 2025;2(2):55-61.



Case Report

Pontic-filled essix retainer as a temporary esthetic solution during clear aligner therapy: A case report

Adil Mohammed¹, Sandeep Shetty¹, Dilshad Umar^{*1}, Faizan Ahmed Khan¹

¹Dept. of Orthodontics, Yenepoya University, Mangalore, Karnataka, India.

Abstract

Background: Temporary tooth replacement before initiation of orthodontic clear aligner therapy can be a challenge, particularly when esthetics in the anterior region are a priority. Traditional solutions such as removable partial dentures, bonded pontics, and Maryland bridges have limitations related to cost, invasiveness, and comfort. The integration of a pontic within an Essix retainer represents an innovative, minimally invasive, and esthetic alternative.

Case Presentation: A 28-year-old male presented with a retained deciduous mandibular incisor associated with mobility and discomfort. The treatment plan involved extraction prior to commencement of clear aligner therapy. To prevent the resulting esthetic and functional deficit during the waiting period for aligner fabrication, a pontic-filled Essix retainer was designed. Digital intraoral scans were segmented using 3D Maestro software, followed by virtual extraction of the deciduous tooth and pontic design. A 3D-printed model was generated, and a 1 mm Essix retainer was vacuum-formed. The pontic space was filled with tooth-colored composite resin, producing an immediate esthetic replacement. The patient reported excellent comfort, speech function, and satisfaction.

Results: The pontic-filled Essix retainer preserved esthetics, maintained space, and allowed seamless integration into the planned aligner therapy. No complications occurred during interim use, and the patient adapted well prior to receiving aligners.

Conclusion: A pontic-filled Essix retainer is a simple, cost-effective, and patient-friendly temporary solution for anterior tooth replacement before aligner therapy. This case highlights its advantages compared with conventional alternatives, while recognizing the need for further research on long-term durability and material optimization.

Keywords: Pontic, Essix retainer, Clear aligner therapy

Received: 23-09-2025; **Accepted:** 23-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Esthetic management during orthodontic treatment is often as important as functional correction, particularly in adult patients seeking clear aligner therapy. The loss or extraction of anterior teeth prior to orthodontic intervention presents a significant clinical dilemma. For patients awaiting aligner fabrication, even a short edentulous period can compromise appearance, psychosocial confidence, and compliance. Conventional temporary replacement strategies including removable partial dentures (RPDs), flipper appliances, resin-bonded pontics, and Maryland bridges each present limitations such as bulkiness, discomfort, impaired speech, risk of debonding, and interference with orthodontic mechanics.¹⁻³

The introduction of Essix retainers has provided orthodontists with a versatile, esthetic, and minimally invasive method for space maintenance. Essix retainers are widely utilized at the end of orthodontic treatment; however, their application as an interim esthetic prosthesis has been relatively underreported. More recently, the possibility of incorporating pontics into aligner trays or retainers has gained attention.⁴⁻⁶ In such approaches, digital technology including intraoral scanning, 3D modeling, and additive manufacturing facilitates precise design of pontics to match extracted teeth.

Clear aligner therapy has rapidly evolved into a mainstream orthodontic modality, offering patients superior esthetics, comfort, and convenience compared to fixed appliances.^{7,8} Aesthetic continuity during therapy is

*Corresponding author: Dilshad Umar
Email: orthodil@gmail.com

particularly valued by adult patients, who often opt for aligners to avoid the visibility of brackets and wires. Addressing interim edentulism before aligner delivery is therefore essential to patient satisfaction and overall treatment success.

This report describes the fabrication and clinical application of a pontic-filled Essix retainer designed as a temporary esthetic solution following extraction of a retained deciduous mandibular incisor. The technique utilized intraoral scanning, digital extraction, pontic design, 3D printing, and vacuum-formed Essix technology. The innovation lies in combining the simplicity and comfort of an Essix retainer with the esthetic continuity of a composite pontic, providing an immediate solution that integrates seamlessly into subsequent aligner therapy.

2. Case Presentation

2.1. Patient history and examination

A 28-year-old male presented for orthodontic consultation with the chief complaint of crowding and retained deciduous teeth. Clinical examination revealed a retained mandibular deciduous central incisor exhibiting mobility and pain on mastication. Radiographic evaluation confirmed root resorption and absence of a permanent successor. The treatment plan involved extraction of the deciduous tooth, followed by clear aligner therapy to resolve crowding and align the dentition. The patient expressed concern regarding esthetics during the waiting period for aligner fabrication and requested an immediate temporary solution.

Table 1: Comparison of temporary tooth replacement options prior to orthodontic aligner therapy

Method	Esthetics	Comfort	Cost	Invasiveness	Effect on Aligners
Removable partial denture (flipper)	Moderate	Low	Low	Non-invasive	Can interfere
Bonded pontic	High	Moderate	Moderate	Involves bonding	May interfere
Maryland bridge	High	High	High	Tooth preparation required	Interferes
Unfilled Essix retainer	Low	High	Low	Non-invasive	Minimal
Pontic-filled Essix retainer	High	High	Low	Non-invasive	Compatible

2.2. Clinical workflow

The clinical procedure began with an intraoral scan of both arches using the Trios 3Shape scanner to establish a precise

digital record (Figure 1). High-resolution scanning ensured accurate capture of the dentition and soft tissue morphology, which was critical for subsequent design steps. The scanned files were imported into 3D Maestro software, where segmentation of individual teeth was performed to allow virtual manipulation of the retained deciduous mandibular incisor. Following this, the deciduous incisor was extracted under local anesthesia, and the extraction was replicated digitally to create an accurate edentulous site in the virtual model (Figure 2). A pontic was then selected from the software’s library, scaled to match the morphology of the extracted tooth, and positioned in the space to achieve symmetry and alignment with the adjacent dentition.

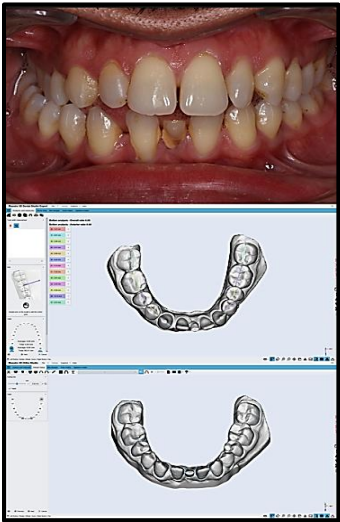


Figure 1: Initial records and digital preparation.

Pre-extraction intraoral view showing the retained deciduous mandibular central incisor along with digital workflow images from 3D Maestro software demonstrating tooth measurement and segmentation of the mandibular arch.



Figure 2: Virtual extraction and pontic design.

Digital simulation of incisor extraction with the corresponding post-extraction intraoral photograph. Pontic

selection from the 3D Maestro library and its placement in the mandibular anterior region are also illustrated.

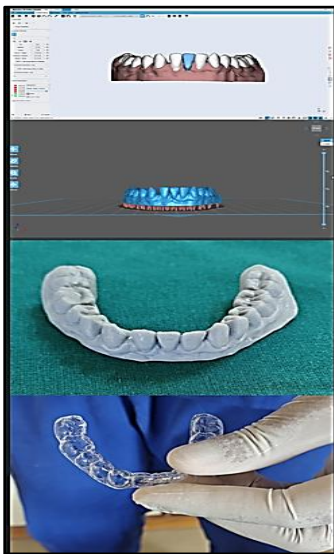


Figure 3: 3D printing and appliance fabrication.

Pontic-integrated digital model prepared for 3D printing, followed by the printed mandibular model. Subsequent steps show vacuum-formed Essix fabrication and chairside filling of the pontic space with tooth-colored composite resin.



Figure 4: Delivery and clinical outcome.

Completed Essix retainer with composite pontic, clinical finishing, and final intraoral view demonstrating successful esthetic integration and patient adaptation.

The final design was exported to Chitubox slicer software and prepared for additive manufacturing. The model was printed with the Phrozen Sonic Mighty 4K resin printer, producing a highly detailed replica of the patient's dentition with the integrated pontic (**Figure 3**). A 1 mm-thick Essix sheet was subsequently vacuum-formed over the printed model using the Erkodent Erkopress Motion thermoforming unit, creating a retainer with excellent adaptation and retention. To complete the appliance, the pontic site was filled with a tooth-colored flowable composite resin, sculpted chairside to reproduce the natural anatomy of a mandibular central incisor, and light-cured to provide strength, polish, and esthetic integration. The finished retainer was delivered immediately after extraction, restoring both function and appearance (**Figure 4**).

The appliance demonstrated a secure fit and did not interfere with occlusion or phonetics. The patient adapted

rapidly, reporting no difficulties with speech or mastication. The esthetic outcome was particularly well received, with the pontic blending harmoniously with adjacent teeth, restoring confidence in social interactions. Comfort was enhanced by the smooth contours and light weight of the retainer, and no soft tissue irritation was reported. Oral hygiene was easily maintained since the appliance could be removed for cleaning, minimizing plaque accumulation. Over the three-week period prior to aligner delivery, the pontic retained its structural integrity and color stability, with no dislodgement or wear. The patient consistently expressed satisfaction during follow-up visits, noting the psychosocial benefit of an uninterrupted smile during the transition to clear aligner therapy. Clinically, the pontic-filled Essix retainer also preserved space effectively and familiarized the patient with appliance wear, thus facilitating a seamless transition to aligner treatment.

The patient reported high satisfaction regarding esthetics, speech, and comfort. The retainer preserved the edentulous space for aligner therapy without interfering with function. Over the 3-week interim period before aligner delivery, no complications such as dislodgement or discoloration were observed.

3. Discussion

Temporary anterior tooth replacement is an essential aspect of orthodontic treatment planning, particularly when extractions precede the commencement of clear aligner therapy. The period between tooth removal and aligner delivery is often a source of anxiety for patients, as the esthetic compromise in the anterior region can negatively affect self-confidence and social interactions. In this context, the present case highlights the practicality and clinical relevance of incorporating a pontic into an Essix retainer using contemporary digital technology.

Recent advances in digital dentistry have introduced several innovative approaches for interim tooth replacement, particularly within the context of aligner-based orthodontic treatment. These methods generally fall into three categories: (1) directly 3D-printed retainers or aligners, (2) thermoformed trays incorporating digitally designed pontics, and (3) fully digital, chairside provisional prostheses.⁹⁻¹¹ Directly 3D-printed retainers offer high precision and reduced laboratory time; however, the available resins demonstrate limited intraoral durability and color stability, necessitating further material refinement.¹²⁻¹⁴ In contrast, the present approach thermoforming an Essix appliance over a 3D-printed model and subsequently sculpting a composite pontic combines the proven adaptability of vacuum-formed retainers with the accuracy of digital modeling, producing an immediate and esthetic provisional solution with minimal cost and invasiveness.

Comparable methods, such as digitally fabricated pontics integrated into clear aligners, have been reported

primarily as short clinical notes or technical tips, with limited emphasis on workflow standardization or clinical outcomes.¹⁵⁻¹⁷ The detailed, replicable protocol described in the present case therefore contributes novel evidence supporting the practical implementation of digitally designed pontic retainers in clinical orthodontics. Moreover, the broader prosthodontic literature on digital provisionalization, including CAD/CAM-milled or fully printed interim prostheses, underscores the increasing shift toward additive, model-driven esthetic solutions.¹⁸⁻²⁰ Collectively, these advances highlight that digitally designed pontic-filled retainers represent a clinically significant, patient-centered innovation that aligns with current trends toward efficient, minimally invasive, and esthetically driven orthodontic care.

Conventional solutions for interim tooth replacement each carry distinct limitations. Removable partial dentures, particularly flipper appliances, have long been employed to restore esthetics; however, their bulk, reliance on clasps, and tendency to interfere with speech often result in poor patient acceptance (**Table 1**). In addition, the forces exerted by clasps on adjacent teeth can complicate orthodontic tooth movement and compromise aligner fit. Bonded pontics offer improved stability and appearance but require adhesive bonding, which risks enamel alteration and may disrupt the precise seating of clear aligners. These restorations also necessitate removal prior to active orthodontic therapy, reducing their practicality in aligner-based treatments.²² Similarly, Maryland bridges, while highly esthetic, are associated with tooth preparation, increased laboratory costs, and extended fabrication time. Given their invasiveness and expense, they are seldom justifiable for short-term esthetic management before orthodontics. Even unfilled Essix retainers, sometimes used as a simple space cover, provide limited visual continuity and fail to offer functional replacement of the missing tooth.

In contrast, the pontic-filled Essix retainer addresses these challenges by combining the strengths of digital design, additive manufacturing, and thermoforming technology. From an esthetic perspective, the composite pontic can be contoured to closely mimic natural morphology, ensuring a seamless smile during the transitional phase. The non-invasive nature of this approach preserves adjacent tooth structure, as no bonding agents or mechanical retention are required. Moreover, the process is efficient and cost-effective, as intraoral scanning, digital segmentation, and in-office 3D printing facilitate rapid fabrication without reliance on external laboratories. Comfort is another key advantage; the appliance is lightweight, smooth in contour, and has negligible impact on speech. Importantly, because the retainer resembles the final shape of aligners, patients adapt more easily to subsequent aligner wear, thereby improving compliance.

Nonetheless, limitations remain. Composite resin pontics are prone to discoloration and wear, especially in

patients with high dietary staining exposure or parafunctional habits. Retention issues may arise if the Essix retainer is inadequately adapted, necessitating periodic adjustment. Furthermore, although the appliance provides esthetic continuity, it lacks the load-bearing capacity of permanent prostheses, and patients must be cautioned against applying excessive biting forces in the pontic region.

Looking forward, material innovations may further refine this technique. The integration of reinforced composites, hybrid resins, or CAD/CAM-milled pontics has the potential to improve strength and longevity. Future studies should not only assess the mechanical performance of pontic-filled retainers but also evaluate long-term outcomes related to periodontal health, patient-reported satisfaction, and efficiency of orthodontic treatment progression. Randomized controlled trials comparing pontic-filled Essix retainers with alternative interim prostheses would provide valuable evidence to establish clinical guidelines and optimize patient care.

In summary, the incorporation of a pontic into an Essix retainer offers a compelling balance of esthetics, comfort, and practicality. By harnessing digital workflows and minimally invasive principles, this technique provides orthodontists with an efficient solution to a common esthetic challenge, while paving the way for further innovation in the interface between orthodontics and restorative dentistry.

4. Conclusion

The pontic-filled Essix retainer provides a practical, esthetic, and cost-effective interim solution for anterior tooth replacement before clear aligner therapy. Its digital fabrication workflow combining intraoral scanning, virtual extraction, 3D printing, and thermoforming ensures precision, comfort, and rapid chairside delivery. Clinicians should focus on achieving accurate adaptation and smooth pontic contouring, while advising patients on proper hygiene and avoidance of excessive biting forces to maintain longevity. Although minor limitations such as potential discoloration and reduced load-bearing strength exist, the technique remains a valuable addition to the orthodontist's armamentarium. Future studies exploring reinforced materials and long-term clinical outcomes could further enhance its applicability and durability.

5. Acknowledgments

We acknowledge the support of department and university during the study.

6. Source of Funding

None.

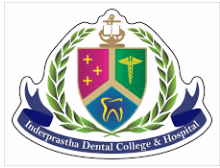
7. Conflicts of Interest

There are no conflicts of interest.

References

- Vaid NR, Revankar AV, Vandekar M. I-Pontics for CAD/CAM Aligners. *J Indian Orthod Soc.* 2013;47(3):169-70. <https://doi.org/10.5005/jp-journals-10021-1152>
- Weir T. Clear aligners in orthodontic treatment. *Aust Dent J.* 2017;62(1):58-62. <https://doi.org/10.1111/adj.12480>
- Putrino A, Barbato E, Galluccio G. Clear aligners: Between evolution and efficiency—A scoping review. *Int J Environmen Res Pub Health.* 2021;18(6):2870. <https://doi.org/10.3390/ijerph18062870>
- Zhang B, Huang X, Huo S, Zhang C, Zhao S, Cen X, Zhao Z. Effect of clear aligners on oral health-related quality of life: A systematic review. *Orthod Craniofac Res.* 2020;23(4):363-70. <https://doi.org/10.1111/ocr.12382>
- Hennessy J, Al-Awadhi EA. Clear aligners generations and orthodontic tooth movement. *J Orthod.* 2016;43(1):68-76. <https://doi.org/10.1179/1465313315Y.0000000004>
- Shetty P, Sateerja R, Singh P, Kozhikadan CJ. An easy technique to fabricate pontic in clear aligners. *IP Indian J Orthod Dentofac Res.* 2023;9(4):300-3. <https://doi.org/10.18231/j.ijodr.2023.052>
- Rossini G, Parrini S, Castroflorio T, Deregibus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: a systematic review. *Angle Orthod.* 2015;85(5):881-9. <https://doi.org/10.2319/061614-436.1>
- Ke Y, Zhu Y, Zhu M. A comparison of treatment effectiveness between clear aligner and fixed appliance therapies. *BMC Oral Health.* 2019;19(1):24. <https://doi.org/10.1186/s12903-018-0695-z>
- Jungbauer R, Sabbagh H, Janjic Rankovic M, Becker K. 3D Printed Orthodontic Aligners—A Scoping Review. *Appl Sci.* 2024;14(22):10084. <https://doi.org/10.3390/app142210084>
- Tsoukala E, Lyros I, Tsolakis AI, Maroulakos MP, Tsolakis IA. Direct 3D-printed orthodontic retainers. A systematic review. *Children.* 2023;10(4):676. <https://doi.org/10.3390/children10040676>
- Panayi N, Cha JY, Kim KB. 3D printed aligners: material science, workflow and clinical applications. In *Seminars in Orthod.* 2023;29(1):25-33. <https://doi.org/10.1053/j.sodo.2022.12.007>
- Alkhamees A. The new additive era of orthodontics: 3D-printed aligners and shape memory polymers—The latest trend—And their environmental implications. *J Orthod Sci.* 2024;13(1):55. https://doi.org/10.4103/jos.jos_211_23
- Shetty P, Sateerja R, Singh P, Kozhikadan CJ. An easy technique to fabricate pontic in clear aligners. *IP Indian J Orthod Dentofac Res.* 2023;9(4):300-3. <https://doi.org/10.18231/j.ijodr.2023.052>
- Weir T. Clear aligners in orthodontic treatment. *Aust Dent J.* 2017;62:58-62. <https://doi.org/10.1111/adj.12480>
- Rossini G, Parrini S, Castroflorio T, Deregibus A, Debernardi CL. Efficacy of clear aligners in controlling orthodontic tooth movement: a systematic review. *Angle Orthod.* 2015;85(5):881-9. <https://doi.org/10.2319/061614-436.1>
- Bakeman EM, Kois JC. Developing and Finalizing Ovate Pontic Sites Utilizing Digital Technology. *J Esth Rest Dent.* 2025;37(5):1203-12. <http://doi.org/10.1111/jerd.13394>
- Sadowsky SJ, Stansbury JW. A completely digital workflow of an interim complete arch fixed implant prosthesis using a novel high-performance 3D printed polymer. *Oral.* 2023;3(4):477-86. <https://doi.org/10.3390/oral3040038>
- Chopra S. Essix appliance—Applications and considerations. *J Adv Med Dent Sci Res.* 2020;8(1):184-6.
- Phoenix RD, Cagna DR, DeFreest CF. Stewart's clinical removable partial prosthodontics. 4th ed. p. 517.
- JJ S. Essix retainers: fabrication and supervision for permanent retention. *J Clin Orthod.* 1993;27:37-45.

Cite this article: Mohammed A, Shetty S, Umar D, Khan FA. Pontic-filled essix retainer as a temporary esthetic solution during clear aligner therapy: A case report. *J Advanc Oral Health.* 2025;2(2):62-66.



Case Report

Evaluation of xenograft collagen membrane as a biodegradable dressing for soft tissue wounds in oral and maxillofacial surgery

Kumar Saket^{1*}, Dibakar Sutradhar², Mahabaleshwara CH², Sandeep BS²

¹Dept. of Maxillofacial Surgery, KVG Dental College and Hospital, Sullia, Karnataka, India.

²Dept. of Maxillofacial Surgery, Rajiv Gandhi University of Health Sciences, Bengaluru, Karnataka, India.

Abstract

Introduction: Wound healing is a complex process affected by both internal and external factors, especially in the oral and maxillofacial area. This study examines how well the Xenograft collagen membrane, a biodegradable dressing, works for soft tissue wounds.

Materials and Methods: We conducted a single-center, randomized controlled trial with 30 patients divided into two groups: Study (n=15) and Control (n=15). The study group received the collagen membrane dressing, while the control group did not receive any dressing. We assessed key factors such as bleeding control, granulation, skin cell development, and scarring after the surgery.

Results: The collagen membranes improved bleeding control, granulation, and skin cell development, which led to better wound healing and less scarring. There were no major complications or infections in the study group.

Conclusion: Xenograft collagen membranes are effective for managing soft tissue wounds in oral and maxillofacial surgery. They offer a good alternative to autologous grafts.

Keywords: Biodegradable Dressing, Epithelialization, Hemostasis, Oral and Maxillofacial Surgery, Soft Tissue Wounds, Wound Healing, Xenograft Collagen Membrane

Received: 04-07-2025; **Accepted:** 22-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Wound healing is a vital biological process that restores tissue integrity. It involves various cellular and biochemical activities that promote tissue repair and regeneration.¹ The oral and maxillofacial area often experiences soft tissue injuries and is more susceptible to conditions like oral submucous fibrosis, squamous cell carcinoma, and traumatic wounds. Effective wound management is critical to prevent complications such as infection, excessive scarring, and contractures.²

In the past, soft tissue wounds in this area were treated with autologous grafts. While these grafts are effective, they come with challenges like donor site pain, longer surgical times, and limited tissue availability.³ Consequently, biological dressings, including Xenograft collagen

membranes, have gained popularity. They offer benefits such as easy application, compatibility with the body, and support for the healing process.⁴

Xenograft collagen membrane made from bovine collagen, and it shows promise as a biodegradable dressing material.⁵ Its use has been found to improve tissue repair by encouraging blood clotting, supporting the growth of granulation tissue, and helping with epithelialization.⁶ This study aims to assess how effective Xenograft collagen is in managing soft tissue wounds in the oral and maxillofacial area.⁷

2. Aims and Objectives

The main goal of this study was to determine how suitable the Xenograft collagen membrane is as a biodegradable dressing for soft tissue wounds in the oral and maxillofacial

*Corresponding author: Kumar Saket
Email: saket0410@gmail.com

area. The secondary goals were to evaluate how well the membrane handles, adheres, and is accepted by patients. The study also looked into complications like allergic reactions, infections, or rejections. Additionally, it aimed to compare clinical outcomes such as blood clotting, granulation, epithelialization, and scarring between wounds treated with the collagen dressing and untreated wounds.

3. Materials and Methods

This study followed the CONSORT guidelines for reporting randomized controlled trials (RCTs). It was a single-center, randomized controlled trial done at a tertiary care center that focuses on oral and maxillofacial surgery. The institutional ethics committee approved the study (Approval No: KVG/267/27718), and all participants gave written informed consent before taking part.

3.1. Participants

The trial included 30 healthy patients aged 18 to 70 years with similar types of soft tissue wounds in the oral and maxillofacial area to ensure consistency. Patients were randomly assigned to either the Study Group, which received a collagen membrane dressing, or the Control Group, which received no dressing. Inclusion criteria were healthy patients classified as ASA I and II. Those with chronic diseases, active infections, poor oral hygiene, or allergies to collagen were not included (**Figure 1**). Wound types were limited to surgical excision defects caused by oral submucous fibrosis or leukoplakia for consistent comparisons(**Figure 2**).

3.2. Randomization and blinding

Participants were randomized using a computer-generated sequence. Opaque, sealed envelopes were used to conceal the allocation. Outcome assessors were blinded to reduce bias.

3.3. Interventions

Preoperative preparation included sedation and local anesthesia. Surgical excision was performed, followed by standard postoperative care, which included prescribed antibiotics and pain relievers. The Study Group received the collagen membrane dressing, while the Control Group had no dressing(**Figure 3**).

3.4. Sample size calculation

The sample size was based on previous studies that looked at the effectiveness of collagen membrane dressings in wound healing. Assuming a clinically significant difference of 20% in wound healing outcomes between the groups, a power of 80%, and a two-sided alpha level of 0.05, at least 15 patients were needed in each group (**Figure 4**).

3.5. Outcome measures

Primary outcomes were hemostasis, granulation tissue formation, epithelialization, wound contracture, pain relief (measured with a Visual Analog Scale, VAS), and infection

rates. Follow-up visits occurred weekly for four weeks to monitor wound healing. Secondary outcomes included patient satisfaction and any adverse reactions.

3.6. Statistical analysis

Data were analyzed using SPSS software (version XX). Continuous variables were reported as mean $\pm$ standard deviation (SD) and compared using independent t-tests. Categorical variables were compared using the chi-square test or Fisher's exact test. A p-value of less than 0.05 was regarded as statistically significant.

4. Results

3.1. Patient demographics

Thirty patients were enrolled and evenly divided into the Study Group (n=15) and the Control Group (n=15). The average age in the Study Group was 53.67 ± 12.19 years, while in the Control Group, it was 52.47 ± 9.49 years. The gender distribution was similar ($p = 0.624$). All wounds resulted from surgical excision of oral submucous fibrosis (60%) or leukoplakia (40%), with no significant differences in baseline characteristics ($p > 0.05$).

3.2. Wound characteristics

Most wounds were located in the buccal mucosa (70%) and the floor of the mouth (30%). Wound sizes ranged from 2 to 4 cm to keep consistency across the groups.



Figure 1: Lesion of soft tissues of oral cavity



Figure 2: Excision of the wound



Figure 3: Collagen membrane used after excision



Figure 4: placement of collagen membrane

3.3. Clinical outcomes

1. Hemostasis: Study Group: 80% achieved satisfactory hemostasis. Control Group: 100% achieved satisfactory hemostasis. Statistical significance: $p = 0.02$.
2. Pain Relief: No significant difference between groups ($p = 0.30$).
3. Granulation Tissue Formation: Study Group: 70% showed substantial granulation tissue formation by week 2. Control Group: 40% showed substantial granulation tissue formation by week 2. Statistical significance: $p = 0.04$.
4. Epithelialization: Study Group: 73.3% achieved good epithelialization at one month. Control Group: 60% achieved good epithelialization at one month. Statistical significance: $p = 0.07$ (trend observed).
5. Contracture: Similar results in both groups (66.7% with good contracture, $p > 0.05$).
6. Infection and Reactivity: No infections in the Study Group. 10% of Control Group patients reported mild reactions (erythema and irritation).
7. Patient Satisfaction: Study Group: 93.3% rated treatment as very effective. Control Group: 72.4% rated treatment as very effective. Statistical significance: $p = 0.03$.

5. Discussion

Wound healing is a complex process that involves hemostasis, inflammation, proliferation, and remodelling.⁷ Collagen, an important part of the extracellular matrix, plays a key role in repairing tissue. This is especially true in the oral and maxillofacial area, where wounds are at risk for infection, scarring, and slow healing due to constant movement, moisture, and bacteria (Velnar et al., 2009).⁸ Biological dressings like collagen membranes, which come from bovine sources, are increasingly popular because they are compatible with the body, easy to use, and effective in helping tissue grow back.⁹

This study reveals significant findings about using Xenograft collagen membrane in soft tissue wounds related to oral and maxillofacial surgery.¹⁰ The Study group showed noticeable improvements in stopping bleeding and forming granulation tissue. This indicates that collagen membranes can effectively manage bleeding and support the early stages of healing.¹¹ These findings match previous studies that found collagen membranes create a favorable environment for cell movement, fibroblast activity, and blood vessel formation, which facilitates tissue repair (Sowjanya et al., 2016; Lee et al., 2001).¹²

The lack of significant differences in pain relief between the two groups suggests that the collagen membrane mainly aids in wound healing, not pain relief.¹³ Similar pain scores imply that healing may gradually reduce pain over time. The use of antibiotics and painkillers in both groups probably helped manage pain during recovery.¹³

Epithelialization was slightly better in the Study group (73.3% compared to 60% in the Control group), but this difference was not statistically meaningful. This could be due to the relatively short follow-up period, which may not have fully shown the benefits of collagen membranes for long-term wound closure. Previous studies have indicated that collagen membranes can help speed up epithelial movement and tissue closure by acting as a scaffold for epithelial cells, suggesting that there may be improved epithelialization over longer periods (Rastogi et al., 2009).¹³

Interestingly, there was no significant difference in contraction between the two groups, even though improvements were noted in other areas for the Study group. This outcome could result from factors that influence wound contraction, such as tension, scar tissue quality, and patient movement. While collagen membranes may reduce excessive scarring in some situations, they might not significantly affect contraction in all wound types (Pruitt & Levine, 1984).¹³

Concerning complications, the absence of infections or allergic reactions in the Study group strongly supports the safety and compatibility of collagen membranes. No negative effects or rejections were observed, showing that Xenograft collagen is well-accepted in oral and maxillofacial areas. In

contrast, mild irritation was noted in the Control group, likely due to the raw tissue being exposed to the outside, which collagen membrane dressings could have minimized (Khan et al., 2011).¹⁴

In terms of patient satisfaction, a higher percentage of patients in the Study group reported positive outcomes, which reflects the objective clinical improvements in healing. Collagen membrane dressings have been shown to enhance both the speed and quality of wound healing, likely leading to greater overall satisfaction (Vastani et al., 2016).

Although the results are encouraging, there are some limitations. The small sample size and brief follow-up period limit how widely these findings can be applied. A larger group with a longer follow-up would yield stronger data about the long-term effects of collagen membranes on healing and scarring. Additionally, comparative studies with other biodegradable membranes or advanced wound care methods are necessary to better understand the advantages of Xenograft collagen in managing soft tissue injuries in oral and maxillofacial surgery.

6. Conclusion

The findings of this study highlight how effective and safe Xenograft collagen membrane is for promoting wound healing in oral and maxillofacial surgery. The study group showed significant improvements in controlling bleeding, forming granulation tissue, and overall patient satisfaction when compared to the control group. There were minimal complications, and no infections were reported. While the outcomes for epithelialization and contracture were similar between the groups, the improved wound healing with Xenograft collagen shows its value as a biological dressing. The lack of adverse reactions further supports its compatibility with the body. However, larger studies with longer follow-up are necessary to fully assess its long-term benefits and compare its effectiveness with other wound care options.

7. Ethical Clearance

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the institutional ethics committee. Informed consent was obtained from all participants before enrollment in the trial. Participants were made aware of the study's aims, procedures, potential risks, and benefits. Their confidentiality and privacy were maintained throughout the research.

8. Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study. The research was conducted independently, without any financial or professional influence from external parties.

9. Source of Funding

This study was funded by the institutional research grant. No external financial support was provided for the study. The funding body had no role in the design of the study, data collection, analysis, or interpretation of the results.

References

1. Velnar T, Bailey T, Smrkolj. The wound healing process: an overview of the cellular and molecular mechanisms. *J Int Med Res.* 2009;37:1528-42. <https://doi.org/10.1177/147323000903700531>
2. Shetty V, Bertolami CN. Wound Healing. In Miloro M, Ghali GE, Larsen P, Waite P (Eds). *Peterson's Principles of Oral and Maxillofacial Surgery*, 2nd edition. Hamilton: BC Decker Inc. 2004:6-15. [https://doi.org/10.1016/s0377-1237\(06\)80173-5](https://doi.org/10.1016/s0377-1237(06)80173-5)
3. Bhattacharya V. Management of soft tissue wounds of the face. *Indian J Plast Surg.* 2012;45(3):436-45. <https://doi.org/10.4103/0970-0358.105936>
4. Rastogi S, Modi M, Sathian B. The efficacy of collagen membrane as a biodegradable wound dressing material for surgical defects of oral mucosa: a prospective study. *J Oral Maxillofac Surg.* 2009;67(8):1600-6. <https://doi.org/10.1016/j.joms.2008.12.020>
5. Kamath VV. Surgical interventions in oral submucous fibrosis: A systematic analysis of the literature. *J Maxillofac Oral Surg.* 2015;14(3):521-31. <https://doi.org/10.1007/s12663-014-0639-3>
6. Edelmayer M, Wehner C, Ulm C, Zechner W, Shafer D, Agis H, et al. Which substances loaded onto collagen scaffolds influence oral tissue regeneration? – An overview of the last 15 years. *Clin Oral Investig.* 2020;24:3363-94. <https://doi.org/10.1007/s00784-020-03520-0>
7. Jasthi VC, Shamim T. Data regarding clinical evaluation of collagen membrane in oral mucosal defects due to oral submucous fibrosis and leukoplakia. *Data Brief.* 2018;18:607-12. <https://doi.org/10.1016/j.dib.2018.03.070>
8. Pradhan H, Gupta H, Sinha V, Gupta S, Shashikanth M. Two wound-covering materials in the surgical treatment of oral submucous fibrosis: A clinical comparison. *J Oral Biol Craniofac Res.* 2012;2:10-4. [https://doi.org/10.1016/S2212-4268\(12\)60004-9](https://doi.org/10.1016/S2212-4268(12)60004-9)
9. Nataraj S, Guruprasad Y, Shetty JN. A comparative clinical evaluation of buccal fat pad and collagen in surgical management of oral submucous fibrosis. *Arch Dent Sci.* 2011;2(4):17-24.
10. Chauhan A. Role of collagen membrane for reconstruction of buccal defects following fibrotic band excision and coronoidectomy in oral submucous fibrosis. *IOSR J Dent Med Sci.* 2017;16(7):74-8. <https://doi.org/10.9790/0853-1607097478>
11. Reddy YR, Srinath N, Nandakumar H, Kanth MR. Role of collagen impregnated with dexamethasone and placetrin in patients with oral submucous fibrosis. *J Maxillofac Oral Surg.* 2012;11:166-70. <https://doi.org/10.1007/s12663-011-0274-1>
12. Pandey A, Sharma NK, Dhiman NK, Jaiswara C, Tiwari P, Singh AK, et al. Comparative evaluation of buccal pad of fat with and without bovine collagen membrane in the management of oral submucous fibrosis: A prospective clinical study. *Natl J Maxillofac Surg.* 2020;11(1):57-63. https://doi.org/10.4103/njms.NJMS_70_19
13. Alkan A, Inal S. Closure of palatal defects following excision of palatal pleomorphic adenomas. *J Contemp Dent Pract.* 2008;9(6):99-107.
14. Patigaroo SA, Patigaroo FA, Ashraf J, Mehfooz N, Shakeel M, Khan NA, et al. Pleomorphic adenoma of hard palate: An experience. *J Maxillofac Oral Surg.* 2014;13:36-41. <https://doi.org/10.1007/s12663-012-0448-5>

Cite this article: Saket K, Sutradhar D, Mahabaleshwara CH, Sandeep BS. Evaluation of xenograft collagen membrane as a biodegradable dressing for soft tissue wounds in oral and maxillofacial surgery. *J Advanc Oral Health.* 2025;2(2):67-70.



Case Report

The invisible threat deep caries progression without pain – (A case report in a young adult)

Safiya Bhat^{1*} 

¹Dept. of Oral and Maxillofacial Pathology Microbiology and Forensic Odontology, Yamuna Institute of Dental Sciences and Research, Mansurpur, Haryana, India.

Abstract

Dental caries continues to be one of the most widespread chronic conditions globally, often advancing silently without noticeable symptoms until significant structural damage occurs. This case report describes a 21-year-old female student with a deep carious lesion in the mandibular first molar discovered incidentally during a routine examination. Despite the absence of spontaneous pain, radiographic and pulp testing indicated irreversible pulpitis requiring endodontic management. This report emphasizes the insidious nature of caries progression, lifestyle-related etiological contributors among young adults, and the importance of early diagnosis through routine dental assessments. Preventive efforts, patient education, and timely treatment remain central to halting disease progression and avoiding complex interventions.

Keywords: Dental caries, Acid-producing bacteria, Pulpal pathology

Received: 03-05-2025; **Accepted:** 13-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Dental caries is a complex, multifactorial, progressive disease resulting from interactions among cariogenic bacteria, fermentable carbohydrates, salivary components, and host susceptibility over time.¹ The World Health Organization reports that nearly all adults—close to 100%—experience dental caries at some point in their lives.² While often associated with pediatric populations, caries remains a significant concern in adolescents and young adults as well, especially those navigating academic stress, irregular routines, and dietary changes.³

Caries development follows a well-understood dynamic process beginning with enamel demineralization, progressing into dentin, and ultimately threatening pulpal vitality.⁴ Dietary sugars fuel bacterial metabolism, leading to acid production and pH reduction, which accelerates demineralization.⁵ When oral hygiene is inconsistent—a common issue among college students—disease progression becomes more pronounced, often remaining unnoticed until symptoms emerge.

However, the presence or absence of symptoms does not always correlate with pathological severity. Deep lesions may remain asymptomatic until pulpal inflammation becomes extensive, making caries detection heavily dependent on routine evaluations.⁶

This case highlights a clinically relevant issue the silent progression of deep caries in young adults with minimal or no subjective symptoms. It reinforces the need for preventive strategies tailored specifically to individuals with high academic or lifestyle-related risk factors.

2. Case Presentation

2.1. Patient information

A 21-year-old female student reported to the dental clinic for a routine oral examination. She denied any persistent pain but mentioned occasional sensitivity to cold beverages, which she attributed to dietary habits rather than pathology.

*Corresponding author: Safiya Bhat
Email: 2216drsafiyaabhat@gmail.com

3. Medical & Social History

1. Medical history No systemic illnesses; no medications.
2. Dental history Last dental visit over 3 years prior.
3. Oral hygiene practices Brushed twice daily using fluoridated toothpaste; rarely flossed.
4. Lifestyle habits Frequent consumption of sugary snacks and carbonated drinks during late-night study sessions.
5. Stress level High due to academic workload—an important contributing factor to irregular diet and oral hygiene lapses.

4. Clinical Examination

1. Intraoral examination revealed
2. Extensive cavitated lesion on occlusal and mesial surfaces of tooth #46.
3. Brown discoloration with softened dentin upon probing.
4. No swelling, sinus tract, or abnormal mobility.
5. Gingival tissues appeared healthy with no periodontal involvement.

The lesion appeared chronic, with dentin destruction suggesting significant bacterial activity and long-standing demineralization.

5. Pulp Vitality Tests

Thermal test (cold spray) Prolonged response, indicating irreversible pulpitis.

Electric pulp testing Heightened sensitivity confirming pulpal irritation.

6. Radiographic Assessment

A periapical radiograph revealed;

1. A well-defined radiolucency extending through dentin and approaching the pulp chamber. **Figure 1**
2. Intact lamina dura and absence of periapical radiolucency. **Figure 2**
3. No widening of periodontal ligament space.

These findings indicated deep caries approximating the pulp without periapical involvement **Figure 1& Figure 2**



Figure 1: Radiographic assessment 1

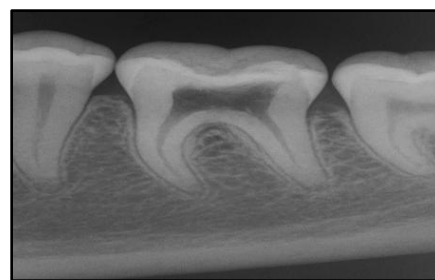


Figure 2: Radiographic assessment 2

6.1. Diagnosis

Tooth #46 Deep dental caries with irreversible pulpitis.

7. Management

The treatment plan was discussed in detail, including consequences of delaying intervention. The patient consented to root canal therapy and full coronal restoration.

8. Endodontic Treatment

Operative Procedures

8.1. Anesthesia and Isolation

1. Local anesthesia administered (2% lidocaine with epinephrine 1:100,000).
2. Rubber dam isolation ensured sterile operative field.

8.2. Access opening & Canal identification

1. Access created on the occlusal surface.
2. Three canals identified mesiobuccal, mesiolingual, and distal.

8.3. Biomechanical preparation

1. Cleaning and shaping performed using rotary NiTi instruments.
2. Irrigation protocol

3% sodium hypochlorite during instrumentation.
Final rinse with 17% EDTA to remove smear layer.

8.3. Obturation

Canals dried and obturated using gutta-percha with resin-based sealer via lateral condensation technique. Temporary restoration applied to protect the tooth until the final restorative phase.

8.4. Definitive restoration

Two weeks later, the patient reported complete relief of symptoms.

1. Composite resin core build-up was performed to reinforce the remaining tooth structure.
2. Crown preparation completed under standard protocols.
3. A full-coverage ceramic crown was fabricated and cemented, restoring function and aesthetics.

8.5. Post-treatment care

1. Reinforced oral hygiene instructions, especially interdental cleaning.
2. Dietary counseling focusing on sugar intake reduction and timing of consumption.
3. Scheduled recall visits for monitoring.

9. Discussion

This case presents several important clinical themes relevant to caries management in young adults.

9.1. Asymptomatic deep caries

Caries progression often remains silent until extensive pulpal involvement occurs. Studies indicate that deep dentinal caries may remain painless, especially in young individuals with robust pulpal reparative abilities.⁶ Early pulpal inflammation is frequently subclinical.⁷

9.2. High-risk lifestyle factors

College and university students experience elevated risk of caries due to

1. Irregular meals and late-night snacking.
2. Increased sugar consumption.
3. Poor sleep cycles affecting immune regulation.
4. Stress-related neglect of hygiene.⁸

Even individuals with adequate brushing habits may develop caries due to inadequate interdental cleaning and pH imbalance in biofilms

10. Importance of Radiographic Evaluation

Detecting deep lesions requires combining clinical findings with radiographic analysis. Visual inspection alone often underestimates lesion depth. In this case, radiography revealed the full extent of carious penetration, preventing progression to necrosis and periapical pathology.

11. Endodontic Treatment as the Gold Standard

For teeth diagnosed with irreversible pulpitis, root canal therapy remains the treatment of choice. When performed under aseptic conditions, success rates are high and long-term prognosis is favourable. The presence of a sealed definitive coronal restoration significantly enhances treatment longevity.

12. Role of Patient Education

Education is essential in modifying risk factors. By understanding the link between lifestyle habits and dental health, patients become active participants in prevention. This case highlights that patient-centered approaches are invaluable in long-term disease control.

13. Conclusion

This case demonstrates the stealthy progression of deep dental caries in a young adult who exhibited minimal symptoms. It emphasizes the need for regular dental check-ups, early radiographic assessment, and timely intervention to avoid invasive treatments. Young adults, particularly those under academic stress, are highly susceptible to caries progression due to lifestyle patterns. Dental professionals must provide personalized preventive counseling and consistent reinforcement to reduce disease incidence and severity.

14. Source of Funding

None.

15. Conflict of Interest

None.

References

1. Fejerskov O, Kidd EAM. Dental Caries The Disease and Its Clinical Management. 2nd ed. Oxford Blackwell Munksgaard; 2008. P. 350.
2. Pitts NB, Zero DT, Marsh PD, et al. Dental caries. *Nat Rev Dis Primers*. 2017;317030. <https://doi:10.1038/nrdp.2017.30>
3. Selwitz RH, Ismail AI, Pitts NB. Dental caries. *Lancet*. 2007;369: 51–59. [https://doi:10.1016/S0140-6736\(07\)60031-2](https://doi:10.1016/S0140-6736(07)60031-2)
4. Al-Ansari AA. Prevalence of dental caries among young adults. *Saudi Med J*. 2014;35:531 <https://doi:10.1155/2022/7132681>
5. Kidd E, Fejerskov O. Histopathology of carious enamel and dentin. *J Dent Res*. 2004;83C35–8.
6. Marsh PD. Dental plaque as a biofilm. *Compend Contin Educ Dent*. 2009;3076–78. 30(2):76-8,
7. Bader JD. Identifying carious lesions. *J Public Health Dent*. 2002;62(4):201–13. <https://doi:https://doi:10.1111/j.1752-7325.2002.tb03446.x>
8. Ng V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature – Part 1. Effects of study characteristics on probability of success. *Int Endod J*. 2007;40(12):921-39. <https://doi:10.1111/j.1365-2591.2007.01322.x>.

Cite this article: Bhat S. The invisible threat deep caries progression without pain – (A case report in a young adult). *J Advanc Oral Health*. 2025;2(2):71-73.



Case Series

Vascular sclerotherapy: A precision treatment of low flow venous malformations in head and neck regions

Anjali Arvind Meshram^{1*}, Kanchan M Shah¹, Jayant S landge¹, Asma Fruitwala¹, Pankaj R Gavali¹

¹Dept. of Oral and Maxillofacial Surgery, Government Dental College and Hospital, Chh. Sambhajinagar, Maharashtra, India.

Abstract

The head and neck area is where low flow vascular abnormalities are most prevalent. Treatment is only necessary for abnormalities that exhibit symptoms. This study utilized repeated injections of 3% sodium tetradecyl sulfate to manage low-flow vascular malformations. While combining sclerotherapy with surgical intervention is generally regarded as the most effective approach, it can lead to both aesthetic and functional issues, particularly in the head and neck areas. Treatment is only necessary for abnormalities that exhibit symptoms. In this study, low flow vascular abnormalities were treated with several injections of sclerotherapy using 3% sodium tetradecyl sulphate.

Keyword: Sodium tetradecyl sulphate, Venous malformation (VnM), Vascular malformations (VM), Sclerotherapy

Received: 28-09-2025; **Accepted:** 24-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Vascular malformations are endothelium-lined vascular channels with narrow walls and a weak muscle layer. Mullikan and Glowacki have distinguished these from hemangiomas or actual vascular tumors. Based on hemodynamics, vascular malformations are clinically classified into high flow and low flow kinds, which can be identified by magnetic resonance imaging (MR) and clinical examination. Arteriovenous malformations represent a form of vascular malformation characterized by high blood flow. Venous, capillary, and lymphatic abnormalities are examples of low flow vascular malformations. Previous literature reports an incidence of 14–65 % of vascular malformations occurring in the head and neck region.^{1,2}

Any organ or tissue in the body may be affected by low flow vascular malformations, but the most frequent locations are mucosal and cutaneous surfaces of head and neck especially anterior two-thirds of tongue, palate, gingiva and buccal mucosa.²⁻³ Pain, disfigurement,

muscular atrophy, impingement on other organs, etc. are among the indications for treatment. Surgery, laser therapy, sclerotherapy, or a combination of surgery and sclerotherapy are among the available therapeutic options. In the current case series, the only treatment for low flow vascular malformations involving the oral cavity is staged sequential sclerotherapy with 3% sodium tetradecyl sulphate (3% STS). Used as the sole treatment in the management of low flow vascular malformations involving oral cavity.

"Sclerotherapy is a primary treatment method that involves injecting a sclerosing agent to trigger inflammation and close off the affected vessels.^{5,6} Localized injections can be effective for small skin or mucosal lesions. Intralesional sclerotherapy using liquid agents is often considered a palliative option for many vascular anomalies and tends to yield favourable results in smaller lesions. Sodium tetradecyl sulfate (3% STS), in use since 1946, remains one of the most commonly employed sclerosing agents, particularly for treating venous and lymphatic malformations.

*Corresponding author: Anjali Arvind Meshram
Email: anjaliamehram017@gmail.com

1.1. Sclerosants

The three types of sclerosants commonly utilized in contemporary therapeutic practice are detergents, osmotic agents, and irritants.¹ Sclerosants damage the endothelial cells of the tunica intima and the luminal 300 µm of the tunica media.² While detergents are less cytotoxic yet disrupt intercellular connections, osmotic and irritating sclerosants are directly cytotoxic. Corrosive substances called irritants damage cellular membranes and cause vascular fibrosis.³

STS is frequently used to treat venous and lymphatic abnormalities, as well as minor varicose veins in the legs.^{3,4} STS works by causing the most endothelium damage and the least amount of thrombus development, which causes the lesion to fibrose² and shrink. In our case series, STS was utilized to treat venous malformations (VnM) in the head and neck region. The closure of the vascular lumen may be temporary or long-lasting, depending on the case. Patient satisfaction and an objective assessment of the lesions' size were among our goals.

2. Materials and Methods

Each patient received an intralesional injection of STS 3% solution using an aseptic approach and local anesthetic infiltration around the lesion's center and periphery. The 3% Sotradecol® solution was injected into each lesion using an insulin syringe and a 26-gauge needle. The agent was delivered without radiological guidance. After inserting the needle, the plunger was retracted to check for blood backflow and ensure that the needle was properly inserted into the middle of the vascular space. The sclerosing chemical was then injected until the lesion blanched. Larger lesions were treated with multiple injections.

All patients received an oral analgesic and a single postoperative dose of intravascular injection of dexamethasone (4 mg) for adults and 0.2 mg/kg for children to reduce inflammation and post-injection pain was noted. Patients were monitored every two weeks, and if there was no or only partial improvement, the treatment was repeated after four weeks. minimum of 0.5–2 ml of the agent was injected into each lesion (at a ratio of 0.5 ml for each 2 cm of lesion size) or a quarter the lesion volume. A compressive dressing was worn for at least 2 hours after injection. The patients in this case series were treated in an outpatient department setting with no radiological guidance.⁵⁻⁹

The response to the treatment was graded as follows: no response (no change in size after injection), mild response (25 % decrease in the size after injection), moderate response, partial response was defined as a reduction in lesion size by less than 75%, a good response as a decrease of 75%, and a complete response as total

lesion resolution with restoration of normal skin or mucosa appearance. Treatment outcomes were evaluated both clinically and through photographic documentation at each visit, with follow-up periods ranging from 6 to 12 months.

3. Case Presentation

3.1. Case 1

14-year-old female presented to the maxillofacial department with a recurring swelling on the upper labial mucosa, which she had noticed for approximately one year. Clinical examination revealed a painless bluish-red lesion on the right buccal mucosa, characterized by a dome-shaped central area (**Figure 1**). Extraoral evaluation showed moderate swelling of the upper lip. T2-weighted MRI scans demonstrated a well-defined lesion in the upper lip measuring approximately 1.1 × 1.6 × 2.5 cm (AP × TR × CC), appearing hyperintense on T2WI/STIR— findings consistent with a hemangioma. Treatment involved three sessions of sclerotherapy using 1.5 cm³ of 3% sodium tetradecyl sulfate (STS).¹⁰⁻¹² Following the initial injection, the patient reported experiencing pain and swelling in the upper lip. Two weeks later, the lesion had reduced to 0.75 × 1 × 2 cm. Following the second session, the lesion's size and thickness decreased further. At the third session (4 weeks later), 1.5 cm³ of 1% STS was administered. Compared to the initial presentation, the lesion had regressed to a 0.5 cm nodule.



Figure 1:

3.2. Case presentation 1

Case 2

An 8-year-old male reported to the department with a bluish, circular lesion on the left buccal mucosa. The lesion had been present for around three months and was asymptomatic.



Figure 2:

3.3. Case presentation 2

Examination revealed a dome-shaped, localized swelling approximately 1 × 0.6 × 0.8 cm in size (**Figure 2**). There was no tenderness or ulceration on palpation. Based on clinical appearance, a provisional diagnosis of venous malformation was made. The patient underwent two sessions of sclerotherapy using 0.6 cm³ of 3% STS. Within three weeks, the lesion had faded and its color matched the surrounding mucosa.¹³⁻¹⁷

Case 3

A 13-year-old male presented with a bluish lesion on the lower right buccal mucosa. Unlike the previous cases, the patient reported a history of both pain and ulceration in the affected area. On examination, a dome-shaped swelling measuring approximately 2 × 1.6 × 0.8 cm was observed. The patient had noticed the lesion about one month earlier. Based on clinical findings and radiological findings, a venous malformation was confirmed. Sclerotherapy was administered using 2 cm³ of 3% STS over three sessions. Two weeks after the first injection, the lesion began to decrease in size, though the patient experienced ulceration at the injection site. After the third treatment session, the lesion had significantly reduced to approximately.



Figure 3:

3.3. Case presentation 3

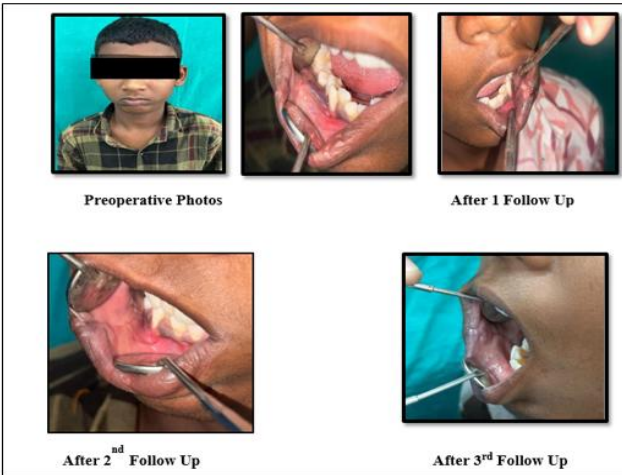


Figure 4:

4. Discussion

The International Society for the Study of Vascular Anomalies categorizes vascular anomalies into two main types based on their biological characteristics: (1) Vasoproliferative lesions, which are vascular neoplasms, and (2) Venous malformations (VM). Vascular malformations are congenital defects that arise from abnormal development of the vascular system during embryogenesis. These anomalies are present at birth, although they may not always be clinically detectable. VMs are estimated to occur in about 1% of live births, though many affected individuals do not seek medical treatment. When found in the oral cavity, vascular malformations can cause significant discomfort and lead to more severe clinical challenges.

While clinical evaluation and patient history are primarily used for diagnosis, imaging techniques such as MRI and digital subtraction angiography are often employed to confirm the condition in certain cases.

Percutaneous sclerotherapy is now considered the primary treatment option for venous malformations. Numerous treatment approaches, including radiation therapy, electrocoagulation, the use of intravascular needles, and various sclerosants, have been reported in the literature. Surgical excision, however, remains difficult and often unfeasible. In cases with larger or deeper lesions, embolization may be used, which involves blocking the blood vessels feeding the malformation. Despite the challenges, surgical excision is generally considered the most effective treatment for benign vascular lesions located in the head and neck region, as other methods may result in permanent tissue damage and progressive scarring. Nonetheless, surgical resection has its limitations, particularly in cases where complete removal is not possible, where there is a risk of heavy bleeding, or when vital structures may be endangered. Extensive oral

surgeries can also impair chewing functionality. In these cases, sclerotherapy offers a viable alternative, especially for smaller lesions or those in aesthetic areas. Sclerotherapy is effective for alleviating symptoms and can lead to partial or complete regression of lesions. The procedure is minimally invasive, cost-effective, and can be performed on an outpatient basis using sclerosants. Sodium Tetradecyl Sulfate (STS) is one of the most commonly used sclerosing agents.

Sclerosants are chemical agents that are injected into veins to cause their closure, a process known as sclerosis. These agents are widely used in the treatment of conditions like varicose veins and other low-flow vascular malformations.

4.1. Sclerosants can also be classified as

1. **Detergents**—Disrupt vein cellular membrane (protein theft denaturation) • Sodium tetradecyl sulfate • Polidocanol • Sodium morrhuate • Ethanolamine oleate
2. **Osmotic agents**— These agents cause cell damage by altering the water balance through osmotic pressure, leading to dehydration of the cell and denaturation of the cell membrane.

Examples of osmotic agents include hypertonic sodium chloride solutions and sodium chloride solutions mixed with dextrose.

3. **Chemical irritants**— sclerosing agents work by causing direct damage to the endothelial cells of blood vessels, which leads to the closure of the vessel. Examples of such agents include chromated glycerin, polyiodinated iodine, and sodium tetradecyl sulfate (STS), which is commonly used in treatments for venous malformations (VM). Another frequently used agent is polidocanol, but in our practice, we prefer the foam preparation of STS due to its fewer side effects and more efficient application. STS is particularly effective in treating larger VMs because its sclerosing action depends on the blood flow and the size of the feeding vessels. At lower concentrations, STS is capable of stripping the endothelial lining of vessels over a significant distance. It also has the ability to induce a hypercoagulable state, possibly by inhibiting protein C, and can promote platelet aggregation.

While sclerotherapy is generally effective, it carries potential risks such as pulmonary embolism, allergic

reactions, nerve damage, discomfort, disseminated intravascular coagulation, tissue necrosis, and sloughing, with some reports of airway impairment. These complications are rare and can generally be minimized with careful administration of the treatment. In some cases, anaphylaxis and pulmonary embolism have been reported, particularly following intravenous injection of STS.

In a study by Minkow et al., the use of intralesional 3% STS injections for intraoral hemangiomas showed positive outcomes with minimal side effects. A similar study on venous malformations treated with 3% STS also observed satisfactory results with complications comparable to those encountered in our case.

Karimi et al. showed that sodium tetradecyl sulfate was effective in reducing the size of venous malformations. In another study, Alfred Inbaraj et al. concluded that sclerotherapy with 3% STS is both safe and effective for treating tongue venous malformations, with minimal complications. He studied studied, 83% demonstrated clinical improvement, with significant reductions in lesion size.

A study by Xena Alakailly, Raja Kummoona, Faisal A. Queresby, Dale A. Baur, and Ariadn E. González further confirmed that sclerotherapy with 3% STS is a simple, safe, and effective method for treating venous malformations. Among the 13 patients treated, 28.57% had complete resolution, 35.7% had a good response, and 14.28% had moderate or mild improvements. Pain and swelling post-injection were common side effects, which were managed with oral analgesics and dexamethasone. Superficial ulcers and ecchymosis were also observed in a few patients, but these healed without any complications.

In our own study, we selected 3% STS due to its proven high effectiveness and minimal complications. Some patients experienced minor side effects, such as small skin ulcers or superficial breakdowns, which were successfully treated by conservative measures. The concentration of STS used was directly related to the severity and size of the lesions. Patients were monitored for six months after treatment, and no recurrences were observed during this period. The results showed a satisfactory reduction in lesion size, and further research with a larger sample size and a broader range of lesion sizes is recommended to determine the full effectiveness of STS injections for slow-flow vascular malformations.

minor complications were noted, severe side effects were rare and could largely be avoided with proper technique. These findings suggest that, when appropriately administered, sclerotherapy is a safe and effective treatment for a wide range of patients with suitable lesions.

5. Conclusion

Intralesional sclerotherapy with 3% Sodium Tetradecyl Sulphate has proven to be an effective treatment, with most patients showing significant lesion reduction or complete resolution. While some local inflammatory reactions and

6. Ethical Consideration

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee. Written informed consent was obtained from all patients (or guardians, where applicable), including permission for use of anonymized data and images. Patient confidentiality was strictly maintained. Participants were informed about the procedure, possible risks, benefits, and their right to withdraw at any stage. All outcomes, including complications, were reported transparently, with no conflicts of interest or undue influence.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. de Ávila Oliveira R, Riera R, Vasconcelos V, Baptista-Silva JC. Injection sclerotherapy for varicose veins. *Cochrane Database Syst Rev*. 2021 Dec 10;12(12):CD001732. doi: 10.1002/14651858.CD001732.
2. Myers K. A history of injection treatments - II sclerotherapy. *Phlebology*. 2019;34(5):303-10. https://doi: 10.1177/0268355518798283.
3. Worthington-Kirsch RL. Injection sclerotherapy. *Semin Intervent Radiol*. 2005;22(3):209-17. https://doi:10.1055/s-2005-921954.
4. Rao J, Wildemore JK, Goldman MP. Double-blind prospective comparative trial between liquid polidocanol and sodium tetradecyl sulfate in the treatment of varicose and telangiect. *Dermatol Surg*. 2005;31(6):631-5; discussion 635. https://doi:10.1111/j.1524-
5. Kobayashi K, Nakao K, Kishishita S, Tamaruya N, Monobe H, Saito K, et al. Vascular malformations of the head and neck. *Auris Nasus Larynx*. 2013;40(1):89-92. https://doi:10.1016/j.anl.2012.02.002
6. Minkow B, Laufer D, Gutman D. Treatment of oral hemangiomas with local sclerosing agents. *Int J Oral Surg*. 1979;8:18-21
7. Karimi E, Jafari M, Aghazadeh K, Sohrabpour S, Tavakolnejad F. Treatment of Head and Neck Venous Malformations with Sodium Tetradecyl Sulfate. *OTO Open*. 2018 Sep 11;2(3):2473974X18797067. doi: 10.1177/2473974X18797067.
8. Alakailly X, Kummoona R, Queresby FA, Baur DA, González AE. The Use of Sodium Tetradecyl Sulphate for the Treatment of Venous Malformations of the Head and Neck. *No j*. 2014;14(2):332-8. https://doi:10.1007/s12663-014-0623-y
9. Candamourty R, Venkatachalam S, Babu MR, Reddy VK. Low flow vascular malformation of the buccal mucosa treated conservatively by sclerotherapy (3% sodium tetradecyl sulfate). *J Nat Sci Biol Med*. 2012;3(2):195-8. https://doi:10.4103/0976-9668.101921.
10. Konez O, Burrows PE. Magnetic resonance of vascular anomalies. *Magn Reson Imaging Clin N Am*. 2002;10(2):363-88. https://doi:10.1016/s1064-9689(01)00009-5
11. El-Merhi F, Garg D, Cura M, Ghaith O. Peripheral vascular tumors and vascular malformations: imaging (magnetic resonance imaging and conventional angiography), pathologic correlation and treatment options. *Int J Cardiovasc Imagi*. 2013;29:379-93. https://doi:10.1007/s10554-012-0106-5
12. Mulliken JB, Glowacki J. Hemangiomas and vascular malformations in infants and children: A classification based on endothelial characteristics. *Plast Reconstr Surg*. 1982;69:412-22. https://doi:10.1097/00006534-198203000-00002.
13. Parsons ME. Sclerotherapy basics. *Dermatol Clin*. 2004;22(4):501-8. https://doi:10.1016/j.det.2004.03.017.
14. Saraf S. Role of sodium tetradecyl sulfate in venous malformations. *Indian J Dermatol*. 2006; 51(4):258-61. https://doi:10.4103/0019-5154.30289
15. Rebeiz E, April MM, Bohigian RK, Shapshay SM. Nd-Yag laser treatment of venous malformations of the head and neck: an update. *Otolaryngol Head Neck Surg*. 1991;105(5):655-61
16. Agarwal S. Treatment of oral hemangioma with 3% sodium tetradecyl sulfate: study of 20 cases. *Indian J Otolaryngol Head Neck Surg*. 2011;64(3):205-7. https://doi:10.1007/s12070-011-0249-z.
17. Kaur M, Sachdeva P, Syal R, Singh S. Role of sclerotherapy in management of low sr flow vascular malformations. *Int Surg J*. 2021;8(4):1234-8. https://doi.org/10.18203/2349-2902.isj20211303

Cite this article: Meshram AA, Shah KM, Landge JS, Fruitwala Gavali PR. Vascular sclerotherapy: A precision treatment of low flow venous malformations in head and neck regions. *J Advanc Oral Health*. 2025;2(2):74-78.



Case Series

Usage of powerscope in class II patients: A case series

Rahul Paul¹, Deepti Yadav^{1*}, Prakher Saini¹, Uchit Gupta¹, Dipankar Sarkar¹, P Tarishma¹¹Dept. of Orthodontics and Dentofacial Orthopaedics, Inderprastha Dental College and Hospital, Ghaziabad, Uttar Pradesh, India.

Abstract

Patient Selection and Diagnosis: This study included five patients (mean age 16.6 years; range 15–18 years) selected from the Department of Orthodontics and Dentofacial Orthopedics. All patients presented with skeletal Class II malocclusion and a positive Visual Treatment Objective (VTO). The inclusion criteria were based on cephalometric readings, specifically an ANB angle greater than 3 degrees and a Witt's appraisal greater than 1 mm. Additionally, assessment of skeletal maturity indicated that all patients were at the CVMI 4 stage. Skeletal, dental, and soft tissue parameters were recorded to evaluate treatment changes.

Treatment Protocol: The treatment was executed in three distinct stages for all cases: Stage 1: Leveling and alignment. Stage 2: Fixed functional appliance therapy (PowerScope). Stage 3: Finishing and detailing.

Conclusion: PowerScope provides significant clinical benefits, including effective mandibular advancement with minimal side effects, reduced dependence on patient compliance, and a low risk of appliance breakage. It is particularly well-suited for noncompliant patients and can substantially improve the soft tissue profile and overall facial esthetics. PowerScope supports stable and long-lasting treatment outcomes by promoting sagittal advancement of the mandible.

Keywords: Class II malocclusion, Powerscope, Fixed functional appliance, Mandibular retrusion, Non-compliance

Received: 09-12-2025; **Accepted:** 02-01-2026; **Available Online:** 05-01-2026

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1. Introduction

Patient cooperation plays a crucial role in the success of orthodontic treatment. When patients do not follow treatment guidelines properly, it can lead to extended treatment durations, damage to teeth and supporting tissues, the need to remove more teeth, and increased stress for both the patient and the orthodontic team.¹ Over the past few decades, various devices and techniques have been developed to reduce the reliance on patient compliance, especially for treating Class II malocclusion.² However, these approaches are not limited to noncompliant individuals but can also be effectively used for cooperative patients. For instance, these methods can be applied in patients nearing the end of their prepubertal growth phase, in the early stages of the permanent phase, or when the second upper molars have already emerged.³ Based on how they function and where they get their anchorage, these appliances can be grouped into two main types:

1. Intermaxillary noncompliance appliances rely on anchorage between the maxilla and mandible and work on both arches to help move the lower jaw forward.⁴
2. Intramaxillary noncompliance appliances use anchorage within the maxilla itself, or from a fixed point, and are designed to move the maxillary molars backward without involving the mandible.⁵

The management of Class II malocclusion is primarily influenced by the severity of the discrepancy and the patient's developmental stage, while also considering compliance. According to McNamara, mandibular retrusion is observed more commonly in Class II malocclusion cases than maxillary protrusion.⁶ As a result, functional appliances that promote forward growth of the mandible are commonly recommended for managing Class II malocclusion caused by mandibular retrusion. Powerscope is a modern advancement

*Corresponding author: Deepti Yadav
Email: deepti.yadav@yahoo.com

in treating Class II malocclusion and is directly derived from the Herbst Type II appliance. It was developed through a collaboration between Dr. Andy Hayes and American Orthodontics. This paper discusses a non-extraction method for managing skeletal Class II malocclusion using the Powerscope appliance.⁷

2. Appliance Design⁸

The Powerscope appliance features a telescopic push-rod design and is universally sized to fit all patients. It is preassembled with attachment nuts, allowing for fast and convenient application during chairside procedures. Also, comes with additional shrimps to allow different amounts of advancements, subject to the treatment plan.



Figure 1: Powerscope assembly appliance insertion⁸

In contrast to conventional Class II correctors, this device does not require pre-assembly, measurement, or manual adjustment of the appliance. It is designed for direct wire-to-wire installation, with anchorage points positioned mesial to the upper first molar and distal to the lower canine. This configuration produces a predominantly horizontal force vector, which may also impart a minor intrusive component on the maxillary molars.

3. Appliance Activation⁸

As illustrated in the diagram, the push rods of the appliance on both the right and left sides have a visual activation indicator in the form of a dot marking. This marker assists in assessing the appliance's activation status. When the dot is visible, it signifies that the appliance is inactive. To restore activation, crimpable shims are placed onto the appliance shaft.

4. Case Series

Five patients with skeletal Class II malocclusion who sought orthodontic treatment were selected from the Department of Orthodontics and Dentofacial Orthopedics, having a positive VTO (Visual treatment objective). The selected patients ranged in age from 15 to 18 years, with a mean age of 16.6 years. To select the class II patients for Powerscope

appliance, cephalometric readings were taken into consideration, including ANB > 3° (the angle formed between hard tissue point A, Nasion, and point B) and Wits > 1mm (the distance between the perpendicular lines drawn from hard tissue point A and Point B over the occlusion plane). All patients fall under CVMI 4 after evaluation for skeletal maturity index. Skeletal, soft, and dental tissue parameters were considered to evaluate the changes (Table 1, Table 2, Table 3).

4.1. Treatment progress

For all the cases, treatment was divided into three stages. Stage 1: Levelling and alignment, followed by stage 2: Fix functional appliance therapy, and finally stage 3: Finishing and detailing. For Stage 1 treatment, it started with 0.014" NiTi wire in maxillary and mandibular arches, followed by 0.016" NiTi, 0.017x0.025" NiTi, and 0.019x0.025" NiTi. Leveling and alignment were done to 0.019x0.025" SS within 7-8 months. After achieving leveling and alignment, stage 2, involving the placement of the Powerscope, was done over 0.019x0.025" SS in both upper and lower arches. In the lower arch, a labial root torque was given to counteract the labial Proclination effect of the fixed functional appliance, and the TPA (Transpalatal arch) was attached to the first maxillary permanent molar to avoid side effects on molars. After 3 months (T1), the evaluation parameters were recorded and compared with pre-treatment parameters.



Figure 2: Visual treatment objective



Figure 3: Pretreatment intraoral images



Figure 4: Treatment progress (0.014 NiTi ligated in upper and lower arches)



Figure 5: Treatment progress (0.019x0.025" SS ligated in upper and lower arches)



Figure 6: Powerscope insertion



Figure 7: Facial Changes after fixed functional therapy

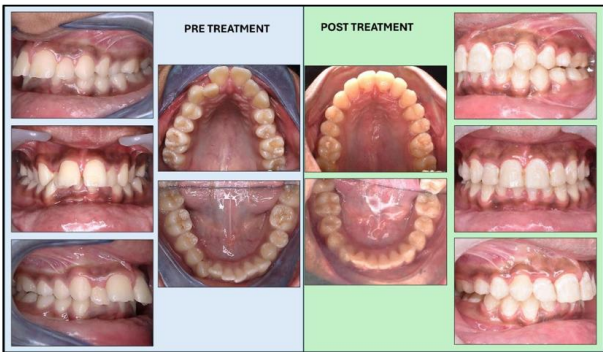


Figure 8: Pretreatment left and post treatment after removal of Powerscope and fixed appliance.

Table 1: Skeletal changes observed in the selected five patients

Patient	Age	Gender	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)
			ANB (0)	ANB (0)	Witts (mm)	Witts (mm)
P1	16	F	5	3	2	2
P2	15	F	8	3	1	1
P3	17	M	9	4	1	1
P4	18	M	5	3	1	1
P5	17	F	7	3	1	1

Table 2: Soft tissue changes observed in the selected five patients

Patient	Age	Gender	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)
			UL-S plane	UL-S plane	Z-angle	Z-angle	LL-S plane	LL-S plane	H angle	H angle
P1	16	F	6	2	24	78	28	2	18	14
P2	15	F	5	2	28	75	22	3	16	13
P3	17	M	5	2	33	76	32	1	14	11
P4	18	M	7	2	25	75	20	2	17	13
P5	17	F	5	2	28	78	22	3	17	12

Table 3: Dental changes observed in the selected five patients

Patient	Age	Gender	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)	T0 (Baseline)	T1 (3 months)
			Overjet	Overjet	Overbite	Overbite	IMPA	IMPA
P1	16	F	6	4	6	2	97	99
P2	15	F	5	3	7	3	96	98
P3	17	M	6	3	6	5	94	96
P4	18	M	5	4	4	4	100	105

5. Discussion

Over the past few decades, advancements in biological knowledge and orthodontic technology have significantly enhanced the effectiveness of conventional treatment modalities.⁹ Nevertheless, the overall success of these treatments remains influenced mainly by the degree of patient cooperation. Class II malocclusion remains a persistent challenge in orthodontic practice. Numerous treatment strategies and various appliances have been employed to address this condition, which is often attributed to underlying skeletal discrepancies.¹⁰ Functional appliances apply orthopedic forces to the mandibular condyle, promoting skeletal modifications by stimulating remodeling in both the condylar region and the glenoid fossa. This leads to repositioning of the condyle within the glenoid cavity and triggers autorotation of the mandible. These appliances are generally categorized into two main types: removable and fixed. Among the fixed functional appliances, PowerScope, recently introduced by American Orthodontics, has been added to the clinician’s armamentarium.¹¹

In this case series, orthodontic patients were treated with Powerscope. Skeletally, Powerscope treatment helped reduce the skeletal Class II component, as depicted by the reduction in ANB angle, for all patients (Table 1). For soft tissue changes, there was a significant decrease in convexity of the profile, accompanied by a reduction in lower lip distance from the S-line, which brought the profile into a more harmonious relationship. This also improved facial aesthetics (Table 2). For dental Changes, there was a reduction in overjet and overbite at the end of treatment, achieved with the use of 50 buccal root torque. This helps maintain the relationship of basal bone to lower incisor, preventing their Proclination due to the use of Powerscope. Overall correction of class II was achieved, resulting in improved facial aesthetics without compromising comfort when compared with traditional methods.

The PowerScope appliance offers several clinical advantages for managing Class II malocclusion. It is a fixed, one-piece device available in a universal size, eliminating the need for laboratory setup or custom fabrication. Its wire-to-wire installation is quick and simple, functioning independently of patient compliance. The internal nickel–titanium (NiTi) spring provides a consistent 260 g of force, ensuring continuous activation throughout treatment. The

appliance is compatible with both banded and bonded molar tubes and does not require headgear tubes or special band assemblies. Furthermore, it reduces the likelihood of debonding at the canine attachment or buccal tube. The appliance features a compact, contoured, polished structure that improves facial aesthetics, enhances patient comfort, and supports effective oral hygiene. The incorporation of a ball-and-socket joint allows for physiological lateral mandibular movements, while the telescopic assembly provides consistent stability and engagement throughout the treatment duration.

6. Conclusion

Extraction-based correction of Class II malocclusion resulting from functional mandibular retrusion is generally discouraged, as it may adversely affect the patient’s soft tissue profile. Class II correctors like the PowerScope appliance offer a more favorable treatment approach in such cases. PowerScope provides significant clinical benefits, including effective mandibular advancement with minimal side effects, reduced dependence on patient compliance, and a low risk of appliance breakage.¹² It is particularly well-suited for noncompliant patients and can substantially improve the soft tissue profile and overall facial esthetics. PowerScope supports stable and long-lasting treatment outcomes by promoting sagittal advancement of the mandible.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Zhong W, Zhou C, Yin Y, Feng G, Zhao Z, Pan Y, et al. Expert consensus on orthodontic treatment of patients with periodontal disease. *Int J Oral Sci.* 2025;17(1):27. <https://doi.org/10.1038/s41368-025-00356-w>
2. McSherry PF, Bradley H. Class II correction-reducing patient compliance: a review of the available techniques. *J Orthod.* 2000;27(3):219–25. <https://doi.org/10.1179/ortho.27.3.219>
3. Batista KB, Thiruvengkatachari B, Harrison JE, O’Brien KD. Orthodontic treatment for prominent upper front teeth (Class II malocclusion) in children and adolescents. *Cochrane Database Syst Rev.* 2018;2018(3):CD003452. <https://doi.org/10.1002/14651858.CD003452>.

4. Fontana M, Cozzani M, Caprioglio A. Non-compliance maxillary molar distalizing appliances: an overview of the last decade. *Prog Orthod*. 2012;13(2):173–84. <https://doi:10.1016/j.pio.2011.10.002>.
5. Kinzinger GSM, Eren M, Diedrich PR. Treatment effects of intraoral appliances with conventional anchorage designs for non-compliance maxillary molar distalization. A literature review. *Eur J Orthod*. 2008;30(6):558–71. <https://doi:10.1093/ejo/cjn047>
6. McNamara JA. Maxillary transverse deficiency. *Am J Orthod Dentofacial Orthop*. 2000;117(5):567–70. [https://doi:10.1016/s0889-5406\(00\)70202-2](https://doi:10.1016/s0889-5406(00)70202-2)
7. Keerthi VN, Kanya SD, Babu KP, Mathew A, Kumar AN. Early prevention and intervention of Class II division 1 in growing patients. *J Int Soc Prev Community Dent*. 2016;6(1):S79–83. <https://doi:10.4103/2231-0762.181191>.
8. Kalra A, Swami V, Bhosale V. Treatment effects of “PowerScope” fixed functional appliance - a clinical study. *Folia Med (Plovdiv)*. 2021;63(2):253–63. <https://doi:10.3897/folmed.63.e52892>
9. Alam MK, Abutayyem H, Kanwal B, A. L. Shayeb M. Future of Orthodontics—A Systematic Review and Meta-Analysis on the Emerging Trends in This Field. *J Clin Med*. 2023;12(2):532. <https://doi:10.3390/jcm12020532>.
10. Lone IM, Zohud O, Midlej K, Proff P, Watted N, Iraqi FA. Skeletal Class II Malocclusion: From Clinical Treatment Strategies to the Roadmap in Identifying the Genetic Bases of Development in Humans with the Support of the Collaborative Cross Mouse Population. *J Clin Med*. 2023;12(15):5148. <https://doi:10.3390/jcm12155148>
11. Arora V, Sharma R, Chowdhary S. Comparative evaluation of treatment effects between two fixed functional appliances for correction of Class II malocclusion: A single-center, randomized controlled trial. *Angle Orthod*. 2018;88(3):259–66. <https://doi:10.2319/071717-476.1>
12. Paulose J, Antony PJ, Sureshkumar B, George SM, Mathew MM, Sebastian J. Power Scope a Class II corrector – A case report. *Contemp Clin Dent*. 2016;7(2):221–5. <https://doi:10.4103/0976-237X.183044>.

Cite this article: Paul R, Yadav D, Saini P, Gupta U, Sarkar D, Tarishma P. Usage of powerscope in class II patients: A case series. *J Advanc Oral Health*. 2025;2(2):79-83

**Short Communication****Specific gravity in prosthodontics: An overlooked determinant of material performance****Arpit Sikri^{1*}**

Dept. of Prosthodontics, Crown & Bridge and Oral Implantology Bhojia Dental College, Baddi, Himachal Pradesh, India.

Abstract

Specific gravity (SG) is a fundamental physical property that reflects the density of a material relative to water. Although widely recognized in material sciences, its significance in prosthodontics remains underappreciated. SG influences the weight, handling characteristics, patient comfort, biomechanical behavior, and long-term clinical success of prosthodontic materials. From denture base polymers and maxillofacial silicones to metallic frameworks and ceramic restorations, SG governs several critical outcomes—including retention, load distribution, and material selection for specialized prostheses. This guest editorial highlights the importance of SG across prosthodontic disciplines, discusses its clinical implications, and underscores the need for increased attention to this parameter in research and education.

Keywords: Alloys, biomechanics, Ceramics, Density, Denture base resin, Material science, Maxillofacial prosthetics, Prosthodontic materials, Specific gravity.

Received: 12-12-2025; **Accepted:** 26-12-2025; **Available Online:** 05-01-2026

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1. Introduction

Specific gravity (SG) is defined as the ratio of the density of a substance to the density of water at a reference temperature. In prosthodontics, SG acts as an essential yet often overlooked determinant of how materials behave clinically. Whether a material is intended for intraoral use or extraoral prosthetic rehabilitation, its SG influences weight, patient acceptance, fabrication ease, and mechanical behavior. Despite its relevance, SG rarely receives explicit attention in academic discussions or clinical decision-making.

2. SG and Denture Base Resins

Polymethyl methacrylate (PMMA), the most commonly used denture base resin, has a specific gravity ranging from 1.15 to 1.19, making it lightweight and suitable for large prostheses such as complete dentures. A lower SG improves patient comfort and reduces the risk of excessive pressure on mucosal tissues. Studies have shown that alternative denture base materials, such as polyamides and flexible resins,

exhibit slightly different SG values, affecting their weight and biomechanical behavior in function.¹ As new CAD/CAM resins emerge, their SG becomes relevant to retention and thickness optimization in digital workflows.²

3. SG in Metallic Prosthodontic Alloys

Metal alloys used in removable partial dentures (RPDs), implant abutments, and fixed prosthodontics exhibit comparatively high SG values. Cobalt–chromium (Co–Cr) alloys (SG ~8.3) and titanium (SG ~4.5) differ significantly, influencing both prosthesis weight and biomechanical load transfer. A heavier RPD framework may enhance stability in some cases but can compromise comfort in others. Titanium, with its lower SG and superior biocompatibility, has become increasingly preferred for implant components and milled prostheses. Comparative analyses indicate that lighter alloys reduce stress concentrations without compromising rigidity, supporting their expanding role in prosthodontics.^{3,4}

*Corresponding author: Arpit Sikri
Email: arpitsikri@gmail.com

4. SG of Ceramics and Hybrid Restorative Materials

Ceramics used in crowns and implant-supported restorations demonstrate SG values ranging from 2.2 to 6.0. Zirconia, with a relatively high SG (~6.0), offers strength but increases the mass of large-span restorations—potentially affecting screw-retained prostheses and cantilevers. Lithium disilicate has a lower SG (~2.4), offering a balanced combination of strength and reduced weight. The SG of hybrid materials, including polymer-infiltrated ceramic networks (PICN), is even lower, contributing to improved shock absorption while reducing prosthetic weight.⁵

Understanding these differences is essential when selecting restorative materials for fragile ridges, elderly patients, and cases requiring extensive prosthetic rehabilitation.

5. SG in Maxillofacial Prosthetics

The concept of SG holds special relevance in maxillofacial prostheses such as facial, auricular, and orbital prostheses. Medical-grade silicones typically have SG values between 1.1 and 1.3. A lightweight prosthesis is crucial to prevent gravitational displacement, especially in large facial defects. Research indicates that modifying silicone formulations to adjust SG can reduce prosthesis weight without compromising mechanical properties.⁶ Additionally, hollowing techniques used in orbital and nasal prostheses specifically aim to reduce overall SG and weight for enhanced retention and patient comfort.

6. SG and Implant Biomechanics

Implant-supported prostheses benefit greatly from materials with optimized SG, as prosthetic weight directly affects implant loading, peri-implant bone response, and prosthesis longevity. Heavy prostheses may increase bending moments on implants, especially in distal extension cases or long-span fixed implant prostheses. Evidence suggests that using lightweight materials such as titanium frameworks, PEKK/PEEK polymers, or milled resin nanocomposites lowers stress distribution on supporting implants.^{7,8}

7. Digital Dentistry and the Future of SG Application

Digital design workflows offer increasing opportunities to integrate SG considerations into prosthesis fabrication. Computer-aided engineering (CAE) can estimate prosthesis mass during virtual planning, helping clinicians select materials that optimize weight, esthetics, and biomechanics. Additive manufacturing further allows infill manipulation to reduce SG without affecting functional surfaces. Emerging materials such as 3D-printed high-impact resins and lightweight metal lattices will likely redefine SG considerations in future prosthodontic practice.⁹

8. SG in Dental Education and Research

Despite its importance, SG receives limited attention in prosthodontic curricula. A stronger emphasis on material density and SG can enhance students' ability to make informed decisions regarding material selection. Furthermore, research comparing SG across conventional and digital materials can inform better clinical guidelines and adaptive workflows.¹⁰

9. Conclusion

Specific gravity, though often overshadowed by mechanical and esthetic properties, plays a vital role in prosthodontic material selection and clinical outcomes. SG influences prosthesis weight, comfort, biomechanics, retention, and long-term success across dentures, implant restorations, alloys, ceramics, and maxillofacial prostheses. As prosthodontics continues to evolve with digital manufacturing and innovative biomaterials, SG must be considered a key material attribute. Greater emphasis in research, education, and clinical practice will ensure more predictable, patient-centered prosthetic rehabilitation.

10. Source of Funding

None.

11. Conflict of Interest

None.

References

1. Phoenix R, Mansueto M, Ackerman N, Jones . Evaluation Of Mechanical And Thermal Properties Of Commonly Used Denture Base Resins. *J Prosthodont*, 2004;13(1):17-27. <https://doi.org/10.1111/j.1532-849x.2004.04002.x>
2. Reem Abualsaud, Mohammed M. Gad, mam Abdulrahman Bin Faisal University- College of Dentistry, *J Int Soc Preven Commun Dent*. 12(2):160. https://doi.org/10.4103/jispcd.JISPCD_310_21
3. Wataha JC. Alloys for prosthodontic restorations. *J Prosthet Dent*. 2002;87(4):351-63. <https://doi.org/10.1067/mpr.2002.123817>
4. Al Jabbari YS. Physico-mechanical properties and prosthodontic applications of Co-Cr dental alloys: a review of the literature. *No J*. 2014;6(2):138. <https://doi.org/10.4047/jap.2014.6.2.138>.
5. Denry I, Kelly JR. Emerging ceramic-based materials for dentistry. *J Dent Res*. 2014;93(12):1235-42. <https://doi.org/10.1177/0022034514553627>.
6. Lewis DH, Castleberry DJ. An assessment of recent advances in external maxillofacial materials. *J Prosthet Dent*. 1980;43(4):426-32. [https://doi.org/10.1016/0022-3913\(80\)90215-2](https://doi.org/10.1016/0022-3913(80)90215-2).
7. Mitra D, Gurav P, Rodrigues S, Khobragade B, Mahajan A. Evaluation of stress distribution in and around dental implants using three different implant–abutment interfaces with platform-switched and non-platform-switched abutments: A three-dimensional finite element analysis. *J Oral Implantol*. 2023;17(4):256-64. <https://doi.org/10.34172/joddd.2023.40723>.
8. Schwitalla A, Müller W. PEEK Dental Implants: A Review of the Literature. *J Oral Implantol*. 2013;39(6):743-9. <https://doi.org/10.1563/aaid-joi-d-11-00002>.
9. Tigmeanu CV, Ardelean LC, Rusu LC, Negrutiu ML, Additive Manufactured Polymers in Dentistry, Current State-of-the-Art and Future Perspectives-A Review,

Polymers 2022;14(17):3658; <https://doi.org/10.3390/polym14173658>.

10. Simon P, Shinde H, Padhye M. Effects of prosthesis weight on stress distribution in implant dentistry. *J Indian Prosthodont Soc.* 2019;19(3):213-20.

Cite this article: Sikri A, Specific gravity in prosthodontics: An overlooked determinant of material performance. *J Advanc Oral Health.* 2025;2(2):84-86.

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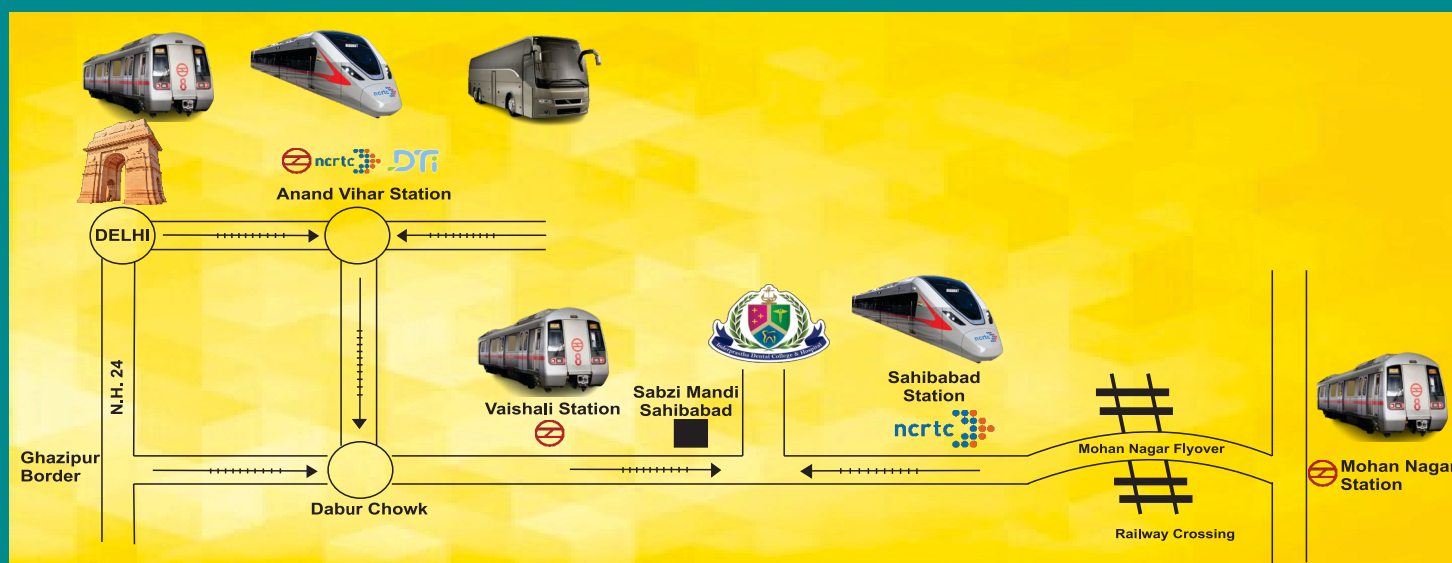
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Volume 2, Issue 2, July-December 2025 The Journal of Advances in Oral Health Page: 40-86