



TAPER

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IDA Thiruvalla - Excellence Through Unity

The Indian Dental Association (IDA) Thiruvalla Branch stands as a beacon of professional excellence, service, and unity among dental practitioners in Central Travancore. Since its inception on 7th December 2008, the branch has been steadfast in its mission to uphold the highest standards of dental practice, promote continuing professional education, and enhance oral healthcare awareness within the community. From a humble beginning with a dedicated group of visionary dental professionals, IDA Thiruvalla has grown into one of the most vibrant and accomplished branches of the IDA Kerala State, earning recognition for its innovative initiatives, active membership, and meaningful contributions to society.

At the heart of IDA Thiruvalla lies a commitment to the ideals of the Indian Dental Association—to advance the science and art of dentistry while fostering ethical practice, professional integrity, and lifelong learning. The branch has consistently provided a platform for dentists to update their knowledge, refine their clinical skills, and engage with the latest developments in dental science. Through Continuing Dental Education (CDE) programmes, scientific conferences, workshops, seminars, hands-on training sessions, and interdisciplinary academic interactions, members are encouraged to pursue excellence in patient care and professional development. Beyond academics, IDA Thiruvalla has always believed that dentistry is a profession deeply rooted in service to humanity. The branch has actively organized Community Dental Health (CDH) programmes aimed at improving oral health awareness among people of all age groups. Regular dental screening camps, school oral health education programmes, awareness campaigns, preventive dental initiatives, and outreach activities have enabled the branch to reach thousands of individuals across urban and rural communities. Special attention has been given to underserved populations, reinforcing the branch's commitment to equitable access to oral healthcare and the social responsibility entrusted to the profession.

Over the years, the branch has successfully undertaken numerous humanitarian and social initiatives, extending support during times of natural disasters, public health emergencies, and community needs. The members of IDA Thiruvalla have consistently demonstrated that the role of a dentist extends beyond the clinic, embracing compassion, empathy, and service to society. These activities have strengthened the bond between the dental fraternity and the community while inspiring younger professionals to uphold the values of social commitment.

One of the greatest strengths of IDA Thiruvalla is its vibrant membership. The branch brings together experienced clinicians, academicians, specialists, consultants, and young practitioners, creating an environment where knowledge, experience, and innovation flourish together. The spirit of camaraderie and mutual respect has fostered lasting professional relationships and friendships, making the branch not merely an association but a close-knit family united by shared goals and values.

Leadership has always played a pivotal role in the remarkable journey of IDA Thiruvalla. Successive office bearers, executive committee members, and dedicated volunteers have worked tirelessly to build a strong organizational culture based on transparency, teamwork, and excellence. Their collective vision and unwavering dedication have enabled the branch to undertake ambitious projects and achieve significant milestones year after year. The achievements of the branch stand as a testimony to the selfless efforts of every member who has contributed to its growth and success.

The branch has been the proud recipient of numerous prestigious awards and recognitions at both the state and national levels, reflecting its outstanding performance in community service, scientific activities, branch administration, membership development, and publication excellence. These accolades are not merely symbols of achievement but reminders of the branch's enduring commitment to excellence and continuous improvement.

Innovation has always remained a defining characteristic of IDA Thiruvalla. By embracing emerging technologies, encouraging evidence-based practice, promoting digital learning, and supporting research and academic excellence, the branch continues to evolve with the changing landscape of modern dentistry. It recognizes that the future of the profession lies in adaptability, collaboration, and a commitment to lifelong education.

This journal is a reflection of that very spirit. It serves as a platform to document our journey, celebrate our achievements, share scientific knowledge, showcase the talents of our members, and preserve the memories of another remarkable year in the history of our branch. It embodies the dedication, creativity, and collective aspirations of every member who contributes to the continued success of IDA Thiruvalla.

As we look toward the future, IDA Thiruvalla remains committed to strengthening professional excellence, expanding community outreach, nurturing young dentists, promoting ethical practice, and contributing meaningfully to the advancement of oral healthcare. Guided by the timeless principles of service, knowledge, integrity, and unity, we continue our journey with renewed enthusiasm and a shared vision of creating healthier smiles and healthier communities.

Together, we celebrate our past, embrace the opportunities of the present, and look ahead with confidence and optimism toward an even brighter future for the dental profession and for IDA Thiruvalla.





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Editors Note



"The future of dentistry depends on the strength of its educational foundation."

It is my great pleasure to bring out the second issue of our journal, TAPER for this year.

A scientific journal is only as strong as the minds behind it. I extend my heartfelt gratitude to every contributor of this issue for their knowledge sharing, immense effort, and dedication.

This issue offers a diverse compilation of clinical insights, featuring comprehensive case reports, an in-depth review article, current concepts in dentistry, and an original study aimed at improving oral health quality. As clinicians, our field evolves rapidly; I hope every reader will thoroughly go through these pages and find practical ways to implement these insights into their daily practice.

To shape a brighter future for dentistry, we must continuously update our knowledge and elevate our clinical practice. I hope you find this issue both engaging and useful.

Happy reading!

Dr. Shibi Mathew .V
Editor



Dear Readers,

It is a privilege to present this edition of our dental journal, a platform dedicated to the advancement of knowledge, clinical excellence, and evidence-based practice in dentistry.

In an era of rapidly evolving technologies, materials, and treatment approaches, continuous learning has become an essential part of every dental professional's journey. A scientific journal serves not only as a source of updated information but also as a bridge connecting research with everyday clinical practice. By encouraging critical thinking, sharing innovative ideas, and promoting ethical, patient-centered care, we strengthen our profession and improve oral health outcomes.

This issue brings together insightful articles, clinical perspectives, case reports, and professional updates that reflect the diversity and dynamism of modern dentistry. We hope these contributions inspire meaningful discussions, encourage lifelong learning, and motivate clinicians and students alike to pursue excellence in their practice.

I extend my sincere appreciation to our authors, reviewers, and readers for their unwavering support and commitment. Your collective efforts continue to uphold the quality and credibility of this journal.

May this edition serve as a valuable resource and a source of inspiration as we work together towards a future of innovation, integrity, and excellence in dentistry.

Happy Reading!

Warm Regards,
Dr. Sijina K.K
Assistant Journal Editor

State First Vice President's Message



Dear Members,

It gives me great pleasure to extend my warm greetings to all the readers of TAPER, the official journal of IDA Thiruvalla Branch, on the release of Volume 10 – Number 2.

With every successive edition, TAPER continues to strengthen its identity as a valuable academic forum that reflects the scientific temperament, clinical expertise, and intellectual contributions of our members. It is heartening to see the journal consistently providing a platform for knowledge sharing, encouraging evidence-based practice, and inspiring professional excellence.

IDA Thiruvalla Branch has always been recognized for its commitment to academic enrichment, quality continuing dental education programmes, meaningful community service initiatives, and active member participation. The enthusiasm and dedication demonstrated by the branch continue to set a benchmark for others and significantly contribute to the growth of IDA Kerala State.

As our profession continues to evolve with rapid technological advancements and emerging treatment modalities, publications such as TAPER play an increasingly important role in keeping clinicians updated while fostering a culture of lifelong learning and critical thinking. I encourage our members, especially the younger generation of dentists, to actively engage in academic writing and research, thereby enriching both the profession and our association.

I extend my heartfelt congratulations to Dr. Shibi Mathew V, Editor, and Dr. Sijina K.K., Assistant Journal Editor, for their exemplary leadership, dedication, and meticulous efforts in bringing out yet another outstanding edition of TAPER. My sincere appreciation also goes to the entire Editorial Board, as well as to all the authors and contributors whose scholarly articles and clinical insights have made this publication informative, relevant, and inspiring.

I remain deeply grateful to the members of IDA Thiruvalla Branch for their continued support, encouragement, and goodwill throughout my journey in dentistry. As my parent branch, IDA Thiruvalla has played a significant role in shaping my professional and leadership journey, and I take great pride in being one of its members while serving the IDA Kerala State Office.

May TAPER continue to grow in stature, inspire excellence in dentistry, and serve as a beacon of academic and professional advancement for many years to come.

With warm regards,

Dr. Rajeev Simon Kurudamannil
First Vice President
IDA Kerala State

State HOPE Vice Chairman's Message



Dear Colleagues,

Warm greetings to all.

It is a matter of great pride and pleasure to extend my heartfelt congratulations to the Editorial Board of Taper – Volume 10, especially the Editor, Dr. Shibi Mathew V., Assistant Editor, Dr. Sijina K.K., and the entire editorial team, for bringing out another excellent edition of our branch journal.

The publication of every volume is a reflection of the commitment, perseverance, and academic vision of the editorial board. Taper has become a valuable platform that encourages scientific thinking, promotes evidence-based dentistry, and provides an opportunity for clinicians, academicians, and students to share their knowledge and clinical experiences.

As the Vice Chairman of IDA Kerala State HOPE, I firmly believe that every dental professional should strive not only for academic excellence but also for professional security and social responsibility. While journals like Taper enrich our knowledge, IDA HOPE safeguards our professional and personal well-being.

Today, with more than 5,000 members, IDA HOPE has become one of the strongest welfare initiatives of IDA Kerala State. Through its Legal Cell, members receive expert medico-legal guidance and financial support during legal proceedings. The HOPE Benevolent Scheme provides substantial financial assistance to the family in the unfortunate event of the death or total permanent disability of a member. HOPE Assure protects our profession through professional indemnity and clinic insurance, while HOPE Medi offers specially designed health insurance benefits for members and their families.

I earnestly encourage every eligible IDA member, particularly our young dentists, to become a part of IDA HOPE at the earliest. Joining HOPE at a younger age not only offers greater benefits and lower admission fees but also provides peace of mind, financial security, and the assurance that our professional family stands together during times of need. HOPE truly reflects the spirit of our profession—caring for those who care for others.

I also encourage our young colleagues and students to actively contribute to future editions of Taper by submitting original research, clinical case reports, review articles, and innovative ideas. Your contributions will strengthen both the journal and our profession.

My sincere appreciation to the Editorial Board for their outstanding efforts in making Taper – Volume 10 a meaningful academic publication. May this journal continue to inspire learning, research, and excellence in dentistry for many years to come.

With warm regards,

Dr. Saji Kurian
Vice Chairman
IDA Kerala State HOPE

President's Message



Dear members,

It gives me great pleasure to welcome you to 3rd edition of VIBES, the official newsletter of IDA Thiruvalla Branch. Each issue is a celebration of our shared journey, capturing the milestones, achievements, and memorable moments that define our vibrant professional family.

As we move forward, our branch continues to uphold the values of excellence, lifelong learning, and community service. Through our scientific programs, social initiatives, outreach activities, and fellowship events, we strive not only to advance dentistry but also to make a meaningful difference in the lives of the people we serve.

This edition reflects the dedication, enthusiasm, and teamwork of our members. Every event, every achievement, and every contribution showcased in these pages is a testament to the spirit of togetherness that makes our branch stronger.

I extend my heartfelt appreciation to our editorial team, Dr. Shibi Mathew V and Dr. Sijina K. K., whose tireless efforts and creativity have once again brought this edition of VIBES to life. My sincere thanks also go to every member who contributed articles, photographs, and reports, making this newsletter a true reflection of our branch activities.

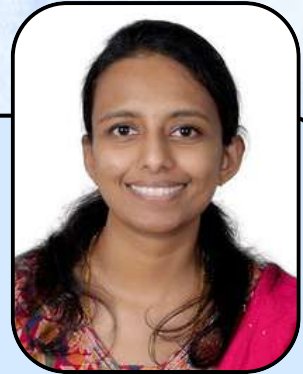
As we look ahead, let us continue to learn, lead, and serve with passion and purpose. I encourage every member to actively participate in our upcoming programs and contribute to future editions of VIBES, so that together we can continue to inspire and grow.

Wishing you an enjoyable and enriching read.

Warm Regards,

Dr. Aswin M. R.
President
IDA Thiruvalla Branch

Hon.Secretary's Message



Dear Members,

Warm greetings to all. As we enter the seventh month of our term, we thank God for guiding us throughout this journey. It is indeed a proud moment for all of us to reflect on the projects we have successfully completed so far.

Teamwork has been our guiding mantra. The executive meetings, the wisdom shared by experienced members, collective decisions, and constructive feedback have all helped us function smoothly and effectively.

Highlights of Our Activities

- CDE Programs: The 3rd and 4th CDE were conducted in June and July, with excellent participation. Emergency drug kits were distributed to members at a nominal cost in June.
- Hep B Vaccination Program: Second phase of the Hepatitis Vaccination State Program was conducted in the month of May.
- CDH activities: CDH check-up camps at Abhayabhavan and Kallooppa was conducted in the month of May. Awareness video was released on World No Tobacco Day on May 31st. Project Jagratha 2.0 with WDC was conducted in June, pamphlet distribution and a flashmob at KSRTC bus stand was done.
- WDC Programs: Program Derma Out was conducted in April and Ergonomics Awareness Class was conducted in May. Project Hridyam was conducted in May. WDC celebrated International Day of Yoga and conducted Project Jagratha 2.0 in June.
- Sports Achievements: Our members actively participated in the State Sports Meet at Paripally on May 16th and 17th. Dr. Anuja Elizabeth Mathew won 3rd prize in 50m swimming. Dr. Aashly Anna Philip and Dr. Anuja Elizabeth Mathew secured 3rd prize in Carroms doubles.
- HOPE: Hope renewals were done by members before the closing dates.

Publications: Special thanks to our Editor Dr. Shibi Mathew V and Co-Editor Dr. Sijina K.K for their dedication in publishing newsletters and journals on time. Their hard work ensures our branch activities are documented and shared consistently.

We have many more programs lined up, and I sincerely hope each member will continue to actively participate in all upcoming activities.

Thank you all once again for your commitment and enthusiasm.

Jai IDA
Dr. Deepthi Santhosh
Hon. Secretary
IDA Thiruvalla

“ADVANCEMENT GENIOPLASTY: A Versatile and Predictable Approach for Correction of Isolated Retrogenia”

Dr. Meekha Mariyam Sabu*, Dr. Akhilesh Prathap**

ABSTRACT

Advancement genioplasty is a well-established surgical technique for the correction of chin deformities, particularly in cases of isolated retrogenia. It offers significant advantages over alloplastic implants by utilizing autogenous bone and allowing precise three-dimensional modification of the chin, including advancement, reduction, vertical alteration, and correction of asymmetry. This case report describes the successful management of a patient presenting with chin retrusion using advancement genioplasty. Preoperative assessment included detailed clinical evaluation and cephalometric analysis to determine the extent of skeletal deficiency and plan the degree of advancement. A horizontal osteotomy of the mandibular symphysis was performed, and the chin segment was advanced by 6 mm to achieve optimal facial balance. The repositioned segment was stabilized using rigid internal fixation with titanium plates and screws. Postoperative evaluation demonstrated significant improvement in facial profile, chin projection, and overall facial harmony. The procedure was well tolerated, with no intraoperative or postoperative complications such as infection, nerve injury, or relapse. The patient expressed high satisfaction with the esthetic outcome. Advancement genioplasty remains a safe, effective, and predictable procedure with excellent stability and minimal complications when performed with proper planning and technique. It continues to be the preferred surgical option for achieving optimal esthetic and functional outcomes in patients with chin deformities.

KEY WORDS: Sliding genioplasty, receding chin, orthognathic surgery

INTRODUCTION

The chin, or mental protuberance, constitutes the most visible and prominent aspect of the lower facial third, playing a crucial role in facial balance and overall harmony. It significantly contributes to an individual's facial identity^{1,2,3}. The perception of the chin's aesthetics varies depending on factors such as gender, ethnicity, cultural background, standards, and prevailing fashion trends⁴.

Deformities of the chin including mandibular retrusion, micrognathia, vertical height discrepancies and facial asymmetry can negatively impact both functional efficacy and facial aesthetics.

This case report presents the effective correction of a retruded chin through advancement genioplasty, emphasizing preoperative assessment, surgical methodology, and postoperative results⁵.

CASE PRESENTATION

A 25-year-old female patient presented with the chief complaint of a “receding chin” and discontentment with her facial profile. The patient reported no significant medical history and had not undergone any previous facial surgeries.

Extraoral examination revealed a convex facial profile with a retruded chin, shallow mentolabial sulcus depth, and lip competence at rest (Fig 1).



Fig 1. picture showing the convex facial profile of the patient, posterior divergence and shallow mentolabial sulcus



Fig 2. Orthopantomogram (OPG)

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Intraoral examination showed a Class I molar relationship with normal overjet and overbite, suggesting that the deformity was primarily confined to the chin rather than a generalized skeletal discrepancy. Radiographic evaluation, including lateral cephalometric analysis, confirmed the presence of retrogenia with normal mandibular length and position (fig2). The soft tissue pogonion was significantly posterior to the ideal esthetic line, indicating the need for anterior repositioning of the chin.

Based on clinical and radiographic findings, a diagnosis of isolated retrogenia was made. Considering the patient's esthetic concerns and the absence of significant occlusal discrepancies, Advancement genioplasty was planned as the treatment of choice.

INTERVENTION

The surgical procedure was performed under general anesthesia with nasotracheal intubation. Standard aseptic precautions were followed. An intraoral vestibular incision was made in the mandibular anterior region, extending from canine to canine, approximately 5 mm below the attached gingiva to preserve the mentalis muscle attachment as much as possible.

Subperiosteal dissection was carried out to expose the anterior surface of the mandible, ensuring careful identification and preservation of the mental nerves bilaterally. A horizontal osteotomy line was marked below the apices of the mandibular incisors and above the inferior border of the mandible, maintaining a safe distance from the mental foramen.



A



B



C



D

Fig 3. Intra-oral surgical procedure (A) Reflecting the mucoperiosteal flap (B) establishing an osteotomy cut 5 mm below the mental foramen along with exposure of the mental vessels (C)advancing the the chin bone by sliding it 6mm (D)fixing of the bone using titanium plates and screws



Fig 4. Immediate post op view

Subperiosteal dissection was carried out to expose the anterior surface of the mandible, ensuring careful identification and preservation of the mental nerves bilaterally. A horizontal osteotomy line was marked below the apices of the mandibular incisors and above the inferior border of the mandible, maintaining a safe distance from the mental foramen.

Under copious irrigation, a horizontal osteotomy was performed through the mandibular symphysis. The genial segment was then carefully mobilized while maintaining soft tissue attachments to preserve vascularity. The mobilized segment was advanced anteriorly by 6 mm, as determined during preoperative planning and intraoperative assessment.

The repositioned segment was stabilized using titanium Mini plates and screws ensuring proper alignment and symmetry. The surgical site was irrigated, hemostasis achieved, and the incision was closed in layers using resorbable sutures. A pressure dressing was applied externally to minimize postoperative edema (fig3,4).



Fig 5.
Post op picture (A) Profile view (B) oblique view (C) facial view

RESULT

The postoperative period was uneventful, with no immediate complications such as excessive bleeding, infection, or nerve injury. Mild edema and discomfort were noted in the initial postoperative days, which subsided with appropriate medication and care. The patient was advised a soft diet and instructed on maintaining oral hygiene.

Follow-up evaluations were conducted at 1 week, 1 month, and 3 months postoperatively. Clinical assessment revealed significant improvement in chin projection, with enhanced facial balance and harmony. The mentolabial sulcus depth was reduced, and lip competence at rest was achieved. The patient expressed high satisfaction with the esthetic outcome (fig5).

There was no evidence of relapse, fixation failure, or infection during the follow-up period. Sensory evaluation indicated no persistent paresthesia in the distribution of the mental nerve, suggesting successful nerve preservation. Radiographic assessment confirmed stable positioning of the genial segment and satisfactory bone healing.

DISCUSSION

Advancement genioplasty is widely regarded as the gold standard for the correction of chin deformity. It's proven surgical method for correcting chin abnormalities, especially in situations of isolated retrogenia, is advancement genioplasty⁵. By using autogenous bone and enabling accurate three-dimensional manipulation of the chin, including advancement, reduction, vertical change, and correction of asymmetry, it

provides substantial advantages over alloplastic implants. This case study details the effective use of advancement sliding genioplasty to treat a patient who had chin retrusion⁶.

To ascertain the degree of skeletal deficit and design the degree of advancement, a thorough clinical evaluation and cephalometric analysis were part of the preoperative assessment. To attain ideal facial equilibrium, a horizontal osteotomy of the mandibular symphysis was carried out, and the chin segment was advanced by 6 mm⁷. Rigid internal fixation with titanium plates and screws was used to stabilising the segment. Following surgery by using autogenous bone and enabling accurate three-dimensional manipulation of the chin, it provides substantial advantages over alloplastic implants. This case study details the effective use of advancement genioplasty to treat a patient who had chin retrusion.

One of the critical aspects of advancement genioplasty is the preservation of the mental nerve. Careful dissection and appropriate placement of the osteotomy line are essential to avoid nerve injury, which can result in temporary or permanent paresthesia. In this case, meticulous surgical technique ensured intact nerve function postoperatively.

Another important consideration is the stability of the advanced segment. Rigid internal fixation using titanium plates and screws provides excellent stability and minimizes the risk of relapse. Studies have shown that sliding genioplasty offers superior long-term stability compared to implants, particularly in cases requiring significant advancement⁸.

Complications associated with sliding genioplasty include infection, hematoma, nerve injury, tooth root damage, and relapse. However, with proper planning and technique, these complications can be minimized. In this case, no significant complications were encountered, highlighting the safety and predictability of the procedure⁹.

The esthetic outcome of genioplasty is influenced not only by skeletal changes but also by soft tissue response. Advancement of the bony chin results in corresponding forward

movement of the overlying soft tissues, improving the facial profile and lower facial contour. The patient in this case demonstrated a marked improvement in profile aesthetics, with enhanced chin projection and facial balance.

Recent advancements in surgical planning, including the use of three-dimensional imaging and computer-assisted simulation, have further improved the accuracy and predictability of genioplasty procedures. Although not utilized in this case, such technologies can aid in precise treatment planning and outcome assessment¹⁰.

CONCLUSION

Advancement genioplasty is a safe, versatile and predictable surgical procedure for the correction of chin deformities, particularly in cases of isolated retrogenia. It contributes with the advantage of using autogenous bone, allowing for versatile three-dimensional correction with excellent stability and minimal complications.

Careful patient selection, thorough preoperative planning, and meticulous surgical technique are essential for achieving optimal functional and esthetic outcomes¹¹. This case put forwards the significant improvement in facial harmony and patient satisfaction that can be achieved with advancement genioplasty. Although newer technologies such as three-dimensional imaging and virtual surgical planning have further enhanced accuracy, conventional methods continue to yield consistent and successful results.

Overall, advancement genioplasty remains a safe, effective, and gold-standard approach for achieving optimal functional and facial esthetic balance. Although newer technologies such as three-dimensional imaging and virtual surgical planning have further enhanced accuracy, conventional methods continue to yield consistent and successful results. Overall, advancement genioplasty remains a safe, effective, and gold-standard approach for achieving optimal functional and facial esthetic balance¹².

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Abstract

Recurrent painful ulcerations of the oral cavity in children present a diagnostic challenge, particularly when cutaneous findings are absent. Such episodes often result in repeated symptomatic treatment and significant impairment of nutrition and speech. We describe a pediatric patient with multiple, self-limiting episodes of extensive oral and lip ulcerations occurring at regular intervals, accompanied by systemic symptoms such as fever and malaise. Clinical examination revealed widespread mucosal involvement with hemorrhagic crusting of the lips, while skin lesions were notably absent. The recurrent and cyclic nature of the condition prompted further evaluation to identify an underlying trigger. Targeted management based on this suspicion led to marked clinical improvement, with resolution of lesions and prevention of further episodes. This case highlights the importance of recognizing characteristic clinical patterns in recurrent oral ulcerative conditions and emphasizes the need for heightened awareness among clinicians to avoid misdiagnosis and delay in appropriate care.

Keywords: Recurrent erythema multiforme, HSV, mucocutaneous disorder

INTRODUCTION

Recurrent erythema multiforme (EM) is a hypersensitivity-mediated mucocutaneous disorder characterized by distinctive target-like lesions, with or without central vesicles or erosions, involving the skin and mucosal surfaces. Although the exact etiology of EM remains unclear, it is commonly triggered by infections—most notably herpes simplex virus (HSV)—other infectious agents, or certain medications.^{1,2}

Oral erythema multiforme has been proposed as a third clinical variant of EM, distinct from EM minor and EM major. It is characterized by ulcerations of the oral mucosa and lips typical of EM, occurring in the absence of cutaneous target lesions. Recurrent episodes of oral EM can significantly impair nutrition, speech, and overall quality of life, particularly in pediatric patients.³

CASE REPORT

A 12-year-old boy reported with a chief complaint of recurrent painful oral ulcers involving the lips, associated with redness of the eyes, fever, malaise, and anorexia. The patient had experienced three similar episodes at regular intervals of approximately 90–98 days, with each episode lasting for an average duration of five days. During each episode, the patient complained of severe odynophagia and difficulty in speech.

There was no history of drug intake or medication use prior to the onset of the lesions. The patient had previously consulted multiple dermatologists and was treated with antibiotics and topical anesthetic gels, which provided only temporary symptomatic relief.

CLINICAL EXAMINATION

On intraoral examination, multiple shallow ulcers were noted involving almost all regions of the oral cavity except the floor of the mouth. The palate showed extensive denuded ulcerations covered with a pseudomembrane. The lips revealed hemorrhagic encrustations with areas of bleeding, and the patient had difficulty in opening the mouth. The lips were edematous, with erythema surrounding the encrusted areas. No cutaneous target lesions were observed elsewhere on the body.

INVESTIGATIONS AND DIAGNOSIS

Considering the recurrent, episodic nature of the lesions and the exclusive oral involvement, a provisional diagnosis of recurrent oral erythema multiforme was made. To evaluate a possible infectious trigger, HSV PCR testing was performed, which returned positive for herpes simplex virus.

MANAGEMENT AND FOLLOW-UP

Based on the clinical presentation and investigation findings, the patient was initiated on empirical therapy, which included: Desloratadine

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(Deskast®) administered once daily at bedtime for 5 days. Deflazacort (Defcort®) 6 mg once daily for 5 days. Oseltamivir phosphate (Fluvir®) 75 mg once daily (0-0-1) for 5 days. Topical clobetasol propionate 0.05% thrice daily for two weeks. On follow-up, the patient demonstrated a marked reduction in pain and inflammation, with significant healing of oral lesions and improvement in oral intake and speech.

PROPHYLACTIC MANAGEMENT AND OUTCOME

Given the challenge of preventing recurrence, prophylactic antiviral therapy with acyclovir was initiated. During five months of follow-up, although prodromal symptoms were noted, no episodes of herpes labialis or erythema multiforme occurred.

DISCUSSION

Erythema multiforme (EM) is a hypersensitivity-mediated mucocutaneous disorder most associated with herpes simplex virus (HSV) infection, particularly in recurrent cases. Assier et al. reported that HSV is the most frequent trigger for recurrent EM and emphasized the importance of identifying viral reactivation in such patients. Similarly, Sokumbi et al. highlighted that EM may present predominantly with oral lesions and may lack classical skin target lesions, leading to frequent misdiagnosis.^{1,2,4,5}

In pediatric patients, recurrent oral EM is often mistaken for recurrent aphthous stomatitis, primary herpetic gingivostomatitis, or drug-induced ulcers, resulting in repeated symptomatic treatment rather than definitive management.⁷ This was evident in the present case, where the child was treated multiple times with antibiotics and topical anesthetic gels by different clinicians, including dermatologists, without addressing the underlying cause.

The cyclical pattern of recurrence (90–98 days) observed in this patient closely resembles descriptions in the literature of HSV-associated recurrent EM. Confirmation of HSV infection by PCR testing in our case supported the diagnosis and allowed initiation of targeted therapy.^{8,9} As reported

by Trayes et al., treating individual episodes alone may not prevent recurrence,³ and antiviral prophylaxis is more effective in patients with recurrent disease.¹⁰

In addition to its antiviral action, acyclovir has been suggested to have immunomodulatory effects, which may help suppress the immune-mediated response responsible for EM. This could explain the favorable response and absence of recurrence observed in the present case.^{11,12}

CONCLUSION

Recurrent oral erythema multiforme is an often-underdiagnosed condition, especially in children, and may be misinterpreted even by dermatologists, particularly when skin lesions are absent. Awareness of the recurrent pattern, periodicity, and HSV association is crucial for early diagnosis. This case highlights the importance of considering HSV-associated oral EM in children with recurrent painful oral ulcers and supports the role of antiviral prophylaxis in preventing recurrence and improving patient quality of life.

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Figure 1(a,b,c): Pretreatment clinical photographs showing multiple oral ulcerations with hemorrhagic lip encrustations and tongue coating



Figure 2(a,b,c): Post treatment clinical photographs showing remission of the lesions

PROSTHODONTIC MANAGEMENT OF ECTODERMAL DYSPLASIA: A REVIEW

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****Dr. Mariya Davis, *****Dr. Feba Mariya

Abstract

Ectodermal dysplasia (ED) is a rare inherited disorder characterised by abnormal development of ectoderm-derived structures, including the teeth, hair, nails, and sweat glands, often resulting in hypodontia or anodontia, underdeveloped alveolar ridges, and compromised oral function and facial esthetics. These manifestations present significant prosthodontic challenges that require early diagnosis and individualised rehabilitation to improve mastication, speech, appearance, and psychosocial well-being, thereby enhancing quality of life. This review discusses the genetic basis, classification, clinical features, and oral manifestations of ED, with particular emphasis on prosthodontic management. Successful management requires a multidisciplinary approach, regular follow-up, and periodic modification of prostheses to accommodate growth and developmental changes.

Keywords:ectodermal dysplasia, hypodontia

INTRODUCTION

The developing embryo has 3 layers: endoderm, mesoderm and ectoderm, which are the basis for the formation of all body structures; these layers arise through a process known as gastrulation. The endoderm gives rise to the gastrointestinal system's epithelial lining, pancreas, thyroid, lungs, and liver, while the mesoderm produces organs such as the heart, circulatory system, genitourinary system, gonads, muscles, bone, and cartilage. The ectoderm layer is responsible for the development of structures like mammary glands, skin, hair, nails, teeth, external ear, melanocytes, cornea, conjunctiva, lacrimal system, and central/peripheral neural system. Any disruption in the formation of organs from these layers can result in developmental genetic defects and lifelong complications[1].

Ectodermal dysplasia is a rare genetic disorder that affects the ectoderm of the developing embryo and affects the structures derived from it. The structures include hair, nails, teeth, sweat glands and sebaceous glands. Freire - Maia defined ED as any syndrome that exhibits at least two of the following features: Trichodysplasia (abnormal hair), abnormal dentition, onychodysplasia (abnormal nails)

and dyshidrosis (abnormal or missing sweat glands).ED is inherited by autosomal dominant, autosomal-recessive or X-linked genetic transmission. There are two main types of this condition: X-linked anhidrotic or hypohidrotic and hidrotic (autosomal type). The most frequently reported manifestations of ED are hypohidrotic ectodermal dysplasia (HED) (Christ-Siemens-Touraine syndrome)[2]

It is estimated that the incidence of the syndrome in men is approximately 1 in 100,000 births, while carriers have an incidence of around 17 in 100,000 women. Diagnosis is typically made based on clinical symptoms and radiographic evidence. However, the ideal way to confirm this is to have a skin biopsy that shows absence or hypoplasia of sweat glands. In addition, numerous genetic tests are also available to diagnose subtypes of ED. Patients with this condition often experience negative impacts on their appearance, particularly in regard to their facial features and missing teeth. Ectodermal dysplasia can be devastating, both physically and emotionally, to patients. Appropriate rehabilitative procedures can improve quality of life for patients with ectodermal dysplasia. The most effective treatment option for improving functionaesthetics and quality of life is by prosthodontic rehabilitation[1].

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GENETIC PATHOGENESIS

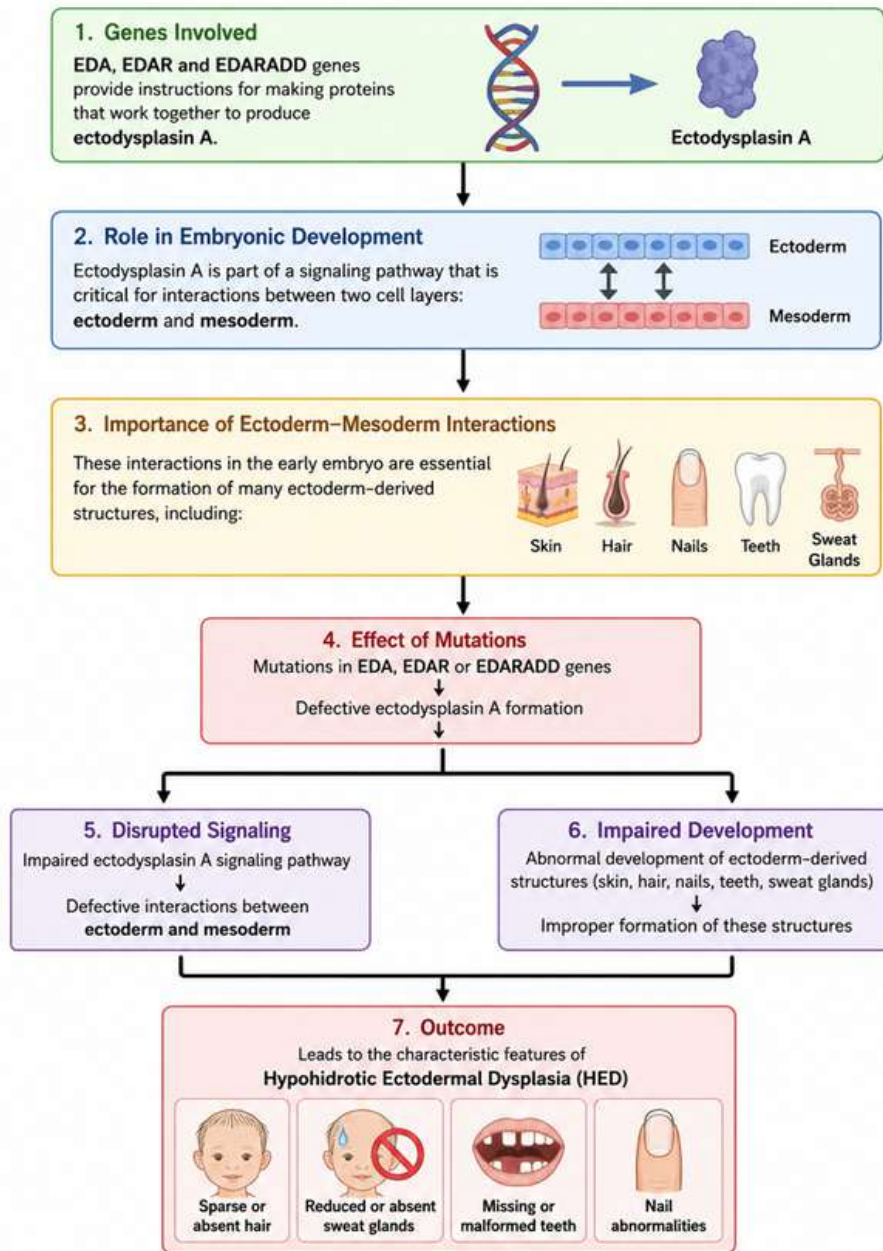


Figure 1: Flowchart showing genetic pathogenesis of Ectodermal dysplasia.

CLASSIFICATION OF ECTODERMAL DYSPLASIA

Currently there are about 150 different types of ectodermal dysplasias. In an attempt to classify these, different subgroups are created according to the presence or absence of the four primary ectodermal dysplasia (ED) defects:

- ED1: Trichodysplasia (hair dysplasia)
- ED2: Dental dysplasia
- ED3: Onychodysplasia (nail dysplasia)
- ED4: Dyshidrosis (sweat gland dysplasia)[3]

GENERAL AND CRANIOFACIAL FEATURES[1,2,3] [figure: 2]

- Sparse, fine, light hair; sparse eyebrows and eyelashes.
- Hypohidrosis or anhidrosis with heat intolerance.
- Dry/scaly skin, nail dystrophy, perioral or periorbital pigmentation.
- Frontal bossing, depressed nasal bridge, prominent chin or lips.
- Reduced lower facial height from absent teeth and reduced vertical dimension.

ORAL MANIFESTATIONS RELEVANT TO PROSTHODONTICS[4,5]

§ Teeth- Hypodontia, oligodontia or complete anodontia; conical, peg-shaped or malformed teeth may remain. [figure:3]

§ Ridges- Underdeveloped and narrow alveolar ridges; poor denture-bearing foundation and reduced vestibular depth. [figure:4]

§ Occlusion and face- Loss of occlusal vertical dimension, protuberant lips and altered facial proportions.

§ Mucosa and Salivary factors- Dry mucosa may reduce comfort and retention; hygiene and tissue care are critical.



Figure:2-craniofacial features



Figure:3- Peg lateral



Figure :4- Underdeveloped ridges

CLINICAL GUIDELINES FOR PROSTHODONTIC MANAGEMENT OF CHILDREN WITH ECTODERMAL DYSPLASIA (ED)

Nowak stated that “treating the paediatric patient with ED requires the clinician to be knowledgeable in growth and development, behavioural management, techniques in the fabrication of prosthesis, the ability to motivate the patient and parents in the use of the prosthesis, and the long-term follow-up for the modification and/or replacement of the prosthesis”[6].

- Early prosthetic rehabilitation: Deliver the initial prosthesis before the child starts school to promote normal appearance, psychosocial development, and early adaptation to the prosthesis.
-

Treatment planning: The decision to initiate treatment should be made jointly by the prosthodontist, parents, and the child (Till and Marques).

- **Behaviour management:** Nussbaum and Carrel advocate sedation for uncooperative children requiring extensive prosthodontic treatment.
- **Nowak discourages sedation,** emphasizing that long-term success depends on patient understanding and cooperation, and recommends the "Tell-Show-Do" technique instead.
- **Patient conditioning:** A series of introductory visits may be necessary to establish trust and prepare the child for treatment.
- **Parental involvement:** Parents can either facilitate or hinder treatment success; therefore, their role should be assessed individually.
- **Pre-treatment counselling:** Both the child and parents should be informed about the treatment procedures, expected prosthesis, benefits, limitations, and maintenance requirements.
- **Regular follow-up:** Young patients with ectodermal dysplasia should be reviewed periodically until growth is complete to monitor prosthesis retention, occlusal changes, tooth eruption, and jaw growth.
- **Definitive rehabilitation:** Parents should be informed that a more permanent prosthetic treatment can be provided after completion of craniofacial growth.
- **Multidisciplinary management:** Successful treatment requires coordination among a pediatric dentist, prosthodontist, orthodontist, oral and maxillofacial surgeon, and speech therapist to provide comprehensive care, particularly in growing patients [5,6]

TREATMENT CONSIDERATIONS

Two main factors affecting the success of dental treatment for ED are

- Insufficiently supported underlying mucosal tissues
- Reduced salivary flow (Blanchaert 1998)

Removable prosthodontics

- Removable prosthodontics is the most commonly reported treatment modality for patients with ED, including complete dentures, removable partial dentures, and overdentures [5].

Complete dentures provide acceptable esthetics and function; however, underdeveloped edentulous ridges may compromise denture retention and stability [5].

- **Overdentures** are the preferred option when teeth are available, as they help preserve the remaining alveolar bone [5].
- **Telescopic overdentures** improve retention, stability, and support while combining the advantages of fixed and removable prostheses. They are also a cost-effective treatment option [7].
- **Magnet-retained dentures** use opposing magnets with like poles facing each other to create a repulsive force, thereby enhancing denture retention, stability, function, and patient comfort [8].
- **Vestibuloplasty and ridge augmentation** may be considered in completely edentulous patients to improve denture support and prosthetic outcomes.
- **Till and Marques** recommend delivering the denture for the arch with the best prognosis first, followed by the second denture 2–4 months later.
- **Age-appropriate prosthetic teeth** should be selected to match the child's stage of dental development, with periodic modifications as the child grows.
- **Regular recall visits** are essential to modify or replace the prosthesis in response to growth, jaw development, and changing functional needs[5].

Fixed prosthodontics

- Fixed prosthodontic treatment is rarely used alone in ED due to the limited number of remaining teeth and the young age of most patients [5].
- **Fixed partial dentures (FPDs)** with rigid connectors should be avoided in growing patients, particularly when crossing the midline, as they may restrict jaw growth [5].
- **Hogeboom** reported separation of a midline detachable fixed prosthesis due to transverse jaw growth, highlighting the importance of accommodating craniofacial growth.
- **Single crowns** can be used regardless of age, although large pulp chambers and short

clinical crowns may present restorative challenges [5].

- Crowns are frequently used in young ED patients despite these limitations [5].
- Crowns and direct composite restorations are commonly combined with removable partial dentures (RPDs) to restore hypoplastic teeth and improve abutment contour, support, and retention [5].

Implant prosthodontics

UCSF has developed a classification system to simplify the protocol to be followed while considering implant therapy in young patients afflicted with Ectodermal dysplasia.

1. Group-1: Missing single tooth with permanent teeth adjacent to the site- To be restored by transitional prosthesis until growth is complete.
 2. Group-2: Missing multiple teeth anteriorly or posteriorly with permanent teeth adjacent to the edentulous areas- Advised to wait until growth is complete, but implants can be considered in selected patients before the cessation of growth.
 3. Group-3: Essentially edentulous- Implants are indicated at an early age if the patient has the potential to be compliant[2].
- Ideal timing for implant placement: After 15 years in girls and 18 years in boys, when craniofacial growth is near completion, provides the most predictable outcomes [5].
 - Retrievable implant prostheses are preferred in growing children to allow adjustments during growth and development [5].

Mandibular Implants

- The anterior mandibular transverse growth is largely complete by 1 year of age [9].
- Congenital absence of teeth may result in reduced vertical facial growth and a decreased mandibular plane angle [10].
- Implants placed between the mental foramina (ages 6–9 years) have shown favorable long-term outcomes, following normal mandibular growth without implant submergence, making this a potential option in selected growing patients [11].

Maxillary Implants

- Ongoing vertical, sagittal, and transverse maxillary growth makes implant placement challenging in growing children [12].

Rigid implant-supported prostheses crossing growth sites should be avoided because they may interfere with normal maxillary development [12].

- Early maxillary implants may become submerged due to remodeling of the nasal floor and maxillary sinus during growth [13].

Bone Augmentation and Implant Outcomes

- Bone augmentation is often required because of severe alveolar bone deficiency, although significant graft resorption occurs, especially during the first 6 months [14].
- Early prosthetic rehabilitation (before school age) is recommended to improve function, esthetics, and psychosocial development [14].
- Implant survival rates in adults with ED are excellent (95% in the maxilla and 97% in the mandible), despite the challenge of inadequate bone.
- Autogenous bone grafting followed by delayed implant placement and implant-supported bar-retained overdentures is a well-established treatment approach.
- Reported complications include peri-implant infections (23%) and prosthetic complications (19%), although 92% of patients would choose implant therapy again.
- Conventional removable prostheses are recommended before implant therapy to restore function and esthetics, condition the child for definitive treatment, and assist in future implant planning until skeletal maturity [15].

CONCLUSION

Ectodermal dysplasia presents significant prosthodontic challenges due to hypodontia or anodontia, underdeveloped alveolar ridges, and craniofacial abnormalities, making early diagnosis and timely prosthodontic intervention essential to restore oral function, facial esthetics, speech, and psychosocial well-being. Removable prostheses remain the treatment of choice during childhood because they accommodate craniofacial growth, while overdentures and implant-supported prostheses provide predictable long-term rehabilitation in appropriately selected patients. Successful management requires regular follow-up, periodic prosthesis modification, and a multidisciplinary approach to achieve optimal functional, esthetic,

and psychological outcomes, thereby improving quality of life.

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Overdentures in Prosthodontic Rehabilitation: A Comparative Review of Tooth-Supported and Implant-Supported Prostheses

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*****Dr. Riya Ann Joseph, *****Dr. Sobin Kurian

Abstract

Overdentures are a predictable and conservative treatment option for rehabilitating partially or completely edentulous patients by preserving natural tooth roots or dental implants to improve retention, stability, and function. They are broadly classified as tooth-supported and implant-supported overdentures, each with distinct indications, classification systems, and attachment mechanisms. This review summarizes the historical development, biomechanical principles, patient selection criteria, clinical and laboratory procedures, and commonly used attachment systems for both modalities. Current evidence suggests that implant-supported overdentures provide superior stability and masticatory efficiency, whereas tooth-supported overdentures remain a biologically favourable and cost-effective alternative when suitable natural abutments are available. An understanding of these treatment options enables clinicians to select the most appropriate approach for achieving long-term functional, esthetic, and patient-centered outcomes.

Keywords: Overdenture; tooth-supported overdenture; implant-supported overdenture; attachments; removable prosthodontics; RP-4; RP-5

INTRODUCTION

The Glossary of Prosthodontic Terms defines an overdenture as any removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants. The concept combines the psychological and functional benefits of a complete denture with the biological advantages conferred by retained abutments, namely preservation of alveolar bone and continued proprioceptive feedback through the periodontal ligament or, in the case of implants, osseoperception.

The overarching aims of overdenture therapy are to provide adequate support, stability, and retention; to increase the longevity of the residual ridge and remaining dentition; to improve masticatory function and phonetics; to preserve bone by reducing the rate of resorption; and to produce a favourable psychological outcome for patients who might otherwise face complete tooth loss. In tooth-supported overdentures specifically, retained roots or teeth continue to transmit occlusal load through the periodontal ligament, slowing residual ridge resorption and increasing the

patient's manipulative skill and confidence in handling the prosthesis. In implant-supported overdentures, osseointegrated fixtures substitute for these functions when natural abutments are absent, additionally restoring occlusal vertical dimension and facial musculature tone.

Advantages common to overdenture therapy include preservation of alveolar bone, maintenance of proprioceptive response, improved support and retention, harmony with arch form, easier periodontal maintenance of retained structures, and high patient acceptance. Recognised disadvantages include increased susceptibility to caries at abutment margins, the need to eliminate bony and soft-tissue undercuts, the risk of over- or under-contouring copings, encroachment on interocclusal or crown height space, compromised esthetics in some designs, and the possibility of periodontal or peri-implant breakdown around the retained abutments. Implant-supported designs carry the additional considerations of greater crown height space requirements, the need for periodic attachment replacement and relining, and a general obligation for more intensive long-term maintenance.

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2. CLASSIFICATION

Overdentures are broadly divided according to the nature of their supporting structures into tooth-supported overdentures, retained by natural teeth or roots, and implant-supported overdentures, retained by osseointegrated implants. Each category has its own accepted sub-classification.



Figure 1. Classification of overdentures by supporting structure and, for tooth-supported designs, by abutment preparation and attachment type.

2.1 Classification of Tooth-Supported Overdentures

Based on the type of prosthesis (Brewer and Morrow), tooth-supported overdentures are divided into four categories:

- **Transitional/Interim overdenture** – obtained by converting an existing removable partial denture, extending the base and adding artificial teeth in self-cure acrylic resin; it becomes an interim overdenture once all remaining teeth in the arch have been removed.

- **Training denture** – not a true overdenture but a device used to allow patients to accommodate to replacement of posterior teeth and palatal coverage, aiding adaptation of swallowing, chewing, and speech.

- **Remote or definitive overdenture** – a conventional complete overdenture constructed over one or more abutment teeth once the residual ridge has healed, fabricated in acrylic resin alone or in conjunction with a metal base.

- **Immediate overdenture** – inserted on the day of extraction, with abutment teeth reduced on the cast prior to surgery.

Based on the method of abutment preparation (Heartwell), tooth-supported overdenture abutments are classified as:

- **Non-coping abutments** – the root is reduced to a coronal height of 2–3 mm, contoured to a dome shape, and restored conservatively with amalgam or composite, usually after endodontic therapy.

- **Abutments with copings** – a cast metal coping with a dome-shaped, chamfered surface is cemented over the prepared root; copings are further divided into short copings (2–3 mm, requiring endodontics) and long copings (5–8 mm, allowing a more conservative reduction and a favourable crown-root ratio).

- **Endodontic therapy with amalgam plug** – the coronal height is reduced to gingival level, root canal treatment is completed, and an amalgam restoration seals the exposed canal.

- **Endodontic therapy with cast coping** – a shallow, dome-shaped casting with a short intracanal post provides a supragingival margin; the post is deliberately kept short so the casting can be removed if caries develops.

- **Endodontic therapy with cast coping and attachment** – used when additional retention is required; the intracanal post is lengthened and the coping strengthened to withstand the increased stress imposed by an attachment.



Figure 2. Abutment preparation techniques for tooth-supported overdentures: (a) non-coping abutment, (b) abutment with cast coping, (c) short versus long cast copings.

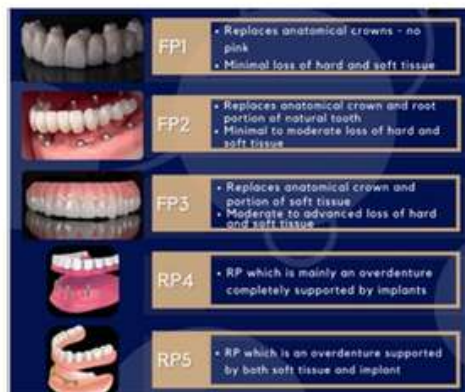
2.2 Classification of Implant-Supported Overdentures

In 1989, Misch described five prosthetic options available in implant dentistry, of which two are removable overdentures retained by implants: RP-4 and RP-5.

- RP-4 (fixed-detachable, implant-supported overdenture) – completely supported by implants and rigid once inserted. The overdenture attachments connect the

prosthesis to a low-profile tissue bar or superstructure that splints the implant abutments, offering the best biomechanical and hygienic situation among removable implant-retained options.

RP-5 (implant-tissue-supported overdenture) – combines variable implant support with soft-tissue support; it most closely resembles a traditional overdenture, is more economical, and relies on the residual ridge for a portion of its support.



(a) RP-4 / RP-5 comparison



(b) Clinical RP-5 overdenture

For the mandible, five treatment options (OD-1 to OD-5) describe increasing numbers and configurations of implants:

- OD-1 – two independent (unsplinted) implants, most commonly in the B and D (canine) positions, retained with an O-ring or Locator attachment; the prosthesis remains RP-5 and must rotate to load the posterior soft tissue.
- OD-2 – the same two implants (B and D) splinted with a superstructure bar without a distal cantilever, reducing loading forces on each implant compared with independent attachments.
- OD-3 – three implants (A, C, and E positions) connected by a bar without a distal cantilever, distributing stress more efficiently and better tolerating moderate parafunction than OD-1 or OD-2.
- OD-4 – four or more implants with a cantilevered superstructure bar, indicated when anterior bone volume and crown height space exceed 15 mm; it provides the greatest biomechanical stability and permits a distal cantilever of up to 10 mm.

- OD-5 – indicated when posterior anatomy is moderate to poor, with attachments placed on the distal cantilevers and an additional O-ring at the midline; it remains RP-5 but with the least soft-tissue support among the RP-5 designs.

For the maxilla, two principal removable options are recognised: Option 1, a maxillary RP-5 implant overdenture, and Option 2, a maxillary RP-4 implant overdenture supported by six to ten implants (commonly placed in the bilateral canine and distal first-molar regions), which is rigid in function and preserves greater bone volume, albeit at higher treatment cost.

Precision attachments used with implant overdentures are additionally classified by their permitted range of motion, from zero (rigid) to six directions (occlusal, gingival, facial, lingual, mesial, and distal). A "type 2" attachment permits movement in two planes and a "type 4" attachment in four planes; the resultant prosthesis movement (PM-0 to PM-2, etc.) depends on both the attachment design and the position of the bar relative to the arc of rotation.

3. INDICATIONS

3.1 Tooth-Supported Overdenture

- Young patients, including those with congenital defects such as cleft palate or ectodermal dysplasia, in whom preservation of alveolar growth potential is important.
- Patients with only a few remaining natural teeth, or teeth of questionable long-term prognosis, that can nonetheless serve as overdenture abutments.
- Clinical situations where retention of a conventional denture would otherwise be difficult, including xerostomia, partial loss of the maxilla or mandible, a high palatal vault with a steep ridge slope, a poorly defined sublingual fold, Class III tongue position, and a knife-edge residual ridge.



Figure 5. A young patient retaining strategically located abutment teeth for a tooth-supported overdenture.

3.2 Implant-Supported Overdenture

- Severe morphologic compromise of the denture-supporting area (advanced ridge resorption).
- Poor oral muscular coordination and low tolerance of the oral mucosa to conventional denture-bearing loads.
- Parafunctional habits that would otherwise overload a tooth-supported prosthesis.
- Active or hyperactive gag reflex, or unrealistic prosthodontic expectations that make a fixed alternative impractical.
- Psychological inability to tolerate a fully removable prosthesis, provided a fixed-detachable (RP-4) design is planned.
- An unfavourable number or location of potential natural abutments, precluding a tooth-supported design.

4. CONTRAINDICATIONS

4.1 Tooth-Supported Overdenture

- Uncooperative or under-motivated patients, and those with a psychological aversion to a removable prosthesis.
- Mental or physical compromise limiting the patient's ability to maintain the prosthesis and abutments.
- Inability to afford the endodontic, periodontal, and prosthodontic components of treatment.
- Reduced interocclusal space or a bony undercut adjacent to the planned abutment.
- Periodontally involved teeth with Grade III mobility, uncorrectable soft-tissue or osseous defects, or failure to establish an adequate zone of attached gingiva.

4.2 Implant-Supported Overdenture

Absolute contraindications to implant placement, and hence to an implant-supported overdenture, include a recent myocardial infarction (particularly in patients on anticoagulant or antihypertensive therapy), a valvular prosthesis (surgery should be deferred 15–18 months owing to the oral cavity's role as a portal of infection), and severe renal disorders such as nephritis, malignancy, or treatment-resistant/uncontrolled diabetes.

5. PROCEDURES

5.1 Patient Selection and Treatment Planning

Successful overdenture therapy depends on two critical decisions: selecting an appropriate patient and establishing a careful, sequential mode of treatment. For tooth-supported designs, factors to be evaluated include whether a fixed or removable partial denture would better serve the remaining dentition, the feasibility of endodontic therapy (single-rooted teeth are ideal candidates), the periodontal condition of prospective abutments (inflammation, pocketing, and inadequate attached gingiva must first be corrected, if necessary with a free gingival graft or apically repositioned flap), the patient's caries susceptibility, the strategic location of the abutment (canines and premolars in the anterior mandible are especially valuable because this region is most prone to resorption), and the overall economics of the proposed treatment plan.

Criteria for selecting a natural tooth as an overdenture abutment include a strategic position (canines or premolars are favoured), sound periodontal health, a favourable crown-to-root ratio (ideally close to 1:2), adequate alveolar bone support, a broad or divergent root configuration, amenability to endodontic treatment, mobility no greater than Grade I, low caries susceptibility, accessibility for oral hygiene, and, above all, patient compliance with long-term maintenance. Two widely spaced abutments, such as bilateral canines, typically provide excellent support and retention; four abutments improve load distribution further, while single-abutment designs, though possible, are technically demanding.

For implant-supported overdentures, treatment planning follows a structured sequence: diagnostic record collection, fabrication of a transitional prosthesis, surgical (fixture) placement, surgical/prosthetic (abutment) connection, fabrication of the definitive restoration, and an ongoing maintenance phase. Pre-operative work-up includes assessment of available bone quantity, selection of an ideal implant configuration and overdenture retention system, fabrication of an implant-positioning (radiographic and surgical) stent, and prescription of pre-operative medication. Diagnostic methods include evaluation of the lip line, the quantity of attached and keratinized gingiva, manual palpation of soft-tissue thickness, mounted study casts on a semi-adjustable articulator, and a three-phase diagnostic imaging protocol: pre-prosthetic implant imaging (to determine bone quantity, quality, and the relationship of vital structures), surgical/interventional imaging (to guide implant placement and assess early healing), and post-prosthetic imaging (to monitor long-term crestal bone levels and implant stability).

5.2 Clinical and Laboratory Steps – Tooth-Supported Overdenture

- Extraction of periodontally hopeless teeth while retaining suitable abutments.
- Post-space preparation and impression of the retained root, using either a polyvinyl siloxane injection technique with a plastic post, a direct pattern built with autopolymerizing acrylic resin, or an indirect technique using an orthodontic wire coated with adhesive and elastomeric impression material.

- Fabrication of the cast coping: an accurate die is poured, a wax pattern carved, the coping cast, and the polished coping cemented onto the prepared tooth.

- Primary impression using an overextended irreversible hydrocolloid material in a custom acrylic tray adapted over the abutments with a spacer of baseplate wax.

- Final impression following border refinement and relief of the tray to allow adequate flow of impression material, followed by boxing and immediate pouring of the master cast.

- Fabrication of record bases and occlusal rims over the abutments, followed by conventional recording of maxillomandibular relationships, tooth selection, arrangement, and try-in.

- Laboratory processing largely mirrors conventional complete denture fabrication, with additional attention to altering the abutment contour on the cast for esthetic tooth positioning and to increasing denture base bulk on the lingual surface to resist fracture.

- Denture insertion, remounting, and selective grinding to perfect the occlusion, followed by post-insertion instructions and enrolment in a structured recall programme.

Because the diameter and location of the interarch space directly influence attachment selection, a minimum of 12–15 mm of interarch space is generally recommended for overdenture attachments or bar frameworks; approximate minimum requirements are 8–10 mm for simple coping-retained overdentures, 10–12 mm for stud attachments such as the Locator, 12–14 mm for bar-and-clip systems, 10–14 mm for resilient telescopic crowns, and 14 mm or greater for fixed-removable systems, as summarised in Table 1.

5.3 Clinical Protocol – Implant-Supported Overdenture

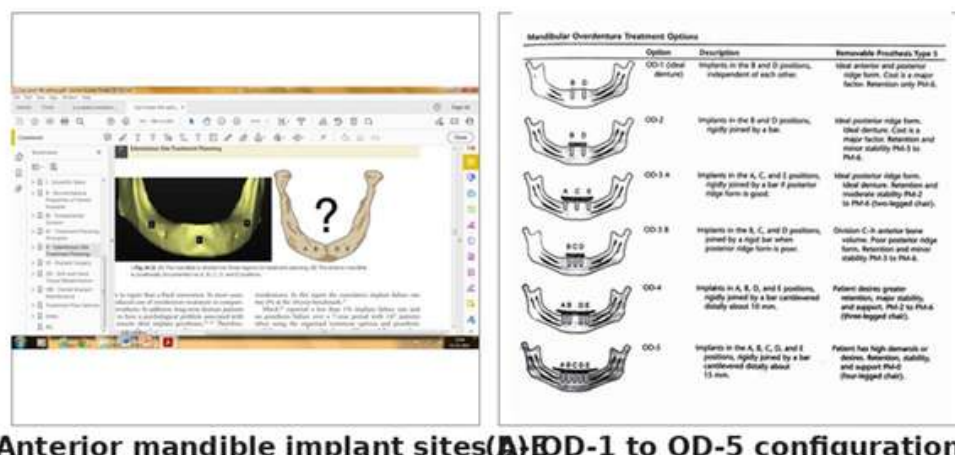
A representative visit-by-visit protocol proceeds as follows. At Visit 1, implants are inserted under local anaesthesia following osteotomy preparation; healing collars are placed, an interarch occlusal registration is made, and a provisional prosthesis and home-care instructions are provided (a corticosteroid may be given to control post-

Prosthetic Component	Minimum Required Interarch Space
Simple overdenture with copings	8–10 mm
Stud attachments (e.g., Locator)	10–12 mm
Bar and clip system	12–14 mm
Resilient telescopic crowns	10–14 mm
Fixed-removable systems	≥14 mm

Table 1. Minimum interarch space required for common overdenture attachment systems.

operative oedema). At Visit 2 (approximately one week later), sutures are removed and soft-tissue healing evaluated, with adjustment of the interim removable prosthesis as required. Between Visits 3 and 6 (weeks 3 to 12), overdenture fabrication proceeds through preliminary and final impressions, a further interarch occlusal registration, shade and tooth selection, and try-in of the completed overdenture, with clearance prepared within the prosthesis to accommodate the retention mechanism. In the final visits (weeks 17–18), retentive clips are incorporated into the overdenture and the fit of the retention mechanism is verified and adapted. Implant site selection in the anterior mandible relies on division of the available bone between the mental foramina into five columns, labelled A through E from

the patient's right; three implants placed in the A, C, and E positions may support an overdenture immediately, with two further implants added later in the B and D positions if additional support is required. The mandibular overdenture requires at least 12 mm of vertical space between the soft tissue and the occlusal plane (approximately 15 mm from bone level) to accommodate the bar, attachments, and denture teeth; insufficient crown height space increases the risk of component fatigue and prosthetic fracture. Implants are loaded according to conventional, early, or immediate protocols; when four implants are used, immediate loading of a mandibular overdenture does not appear to jeopardise implant survival, and both splinted and unsplinted implants can withstand the biomechanical demands of early loading.



Anterior mandible implant sites (A-E) OD-1 to OD-5 configurations
Figure 6. (a) Division of the anterior mandible into implant sites A-E between the mental foramina; (b) OD-1 to OD-5 implant configurations.

Impression-making for the definitive implant overdenture typically begins by relieving and relining the provisional prosthesis with a soft-tissue conditioner, followed by verification of occlusion. Individual attachment abutments are picked up directly in the final impression using impression copings coated with adhesive, after which a master cast is beaded, boxed, and poured in dental stone. A verification jig is then used to confirm passive fit together with vertical dimension and centric relation prior to processing.

6. ATTACHMENTS

Attachments are precision devices, typically comprising a male and a female component, that are secured to the abutment (natural tooth or implant) and engage a corresponding housing embedded in the fitting surface of the overdenture, thereby enhancing its retention and stability.

6.1 Attachments for Tooth-Supported Overdentures

Three principal categories of attachment are used with natural tooth abutments: stud, bar, and magnetic systems.

Stud attachments – the simplest design, comprising a male stud usually cemented to a metal coping on the abutment and a female housing embedded in the denture base. Extraradicular stud systems, in which the male element projects from the root surface, include the Gerber anchor (available in a rigid or vertically resilient form, with readily replaceable male and female components), the Rothermann attachment (a grooved male engaged by a C-shaped female ring, useful where interocclusal space is limited), and the Ceka attachment (a splitting titanium post engaging a compressible plastic female sleeve, which can also permit limited rotational movement). Intraradicular stud systems, in which the housing is incorporated within the root itself, include the Zest anchor (a cemented female sleeve engaging a nylon post with a ball head) and the Quinlivan attachment (a prefabricated resin ball incorporated into the coping, engaged by an O-ring housing only 3 mm in height, suited to limited interarch space). As a general principle, one stud attachment per side of the arch is usually sufficient; adding further attachments does not necessarily increase retention and may weaken the prosthesis or complicate hygiene.



Figure 7. Stud attachment systems for tooth-supported overdentures: (a) Gerber anchor, (b) Rothermann attachment, (c) Ceka attachment, (d) Zest anchor system, (e) Quinlivan attachment.

Bar attachments – a preformed metal or plastic bar contoured to splint two or more abutment teeth together, running parallel to and overlying the residual ridge, providing both splinting of the abutments and retention/support of the prosthesis. Bar units are rigid, transmitting occlusal stress entirely

to the abutments (tooth-borne), whereas bar joints permit a degree of rotational movement and share load between the abutments and the residual ridge (tooth-tissue-borne). Common systems include the Hader bar (a preformed bar with retentive plastic clips that can be added or tightened to increase retention), Dolder bar (a

parallel-sided, rounded bar engaging a frictional sleeve), the Baker clip (a small U-shaped clip fitting over a round wire, soldered for retention), and the

Ackermann/CM clip (similar in principle to the Baker clip, but smaller and easier to fix, well suited where a bar joint design is indicated).

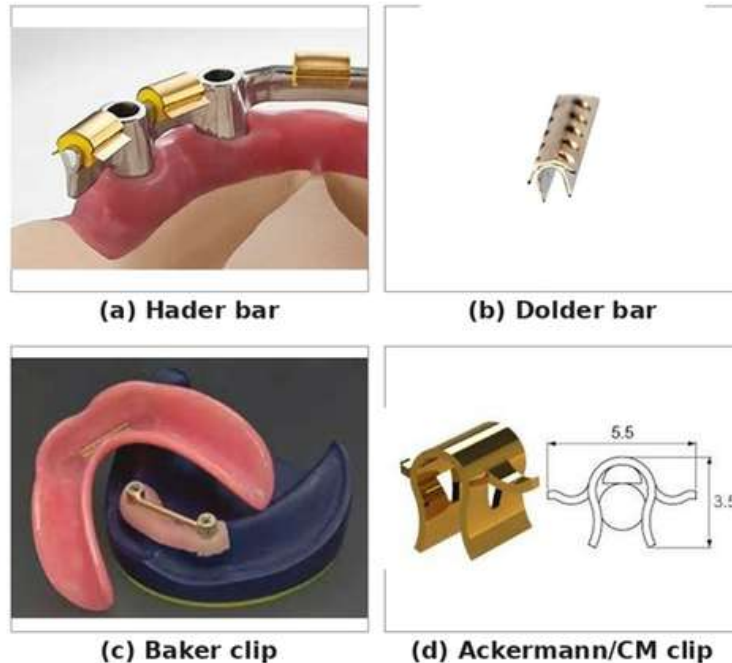


Figure 8. Bar attachment systems: (a) Hader bar, (b) Dolder bar, (c) Baker clip, (d) Ackermann/CM clip.

- **Magnetic attachments** – a detachable stainless-steel keeper is cemented or screwed to the prepared abutment, paired with a cylindrical magnet of opposite polarity embedded in the denture; retentive force is modest (approximately 250 g) but has improved with the development of cobalt-platinum and rare-earth (samarium-cobalt and iron-neodymium-boron) alloys, which achieve

high field strength in a smaller magnet, comparable in size to conventional stud retainers.

Overdenture (OT) caps used with several intraradicular attachment systems are colour-coded to indicate the retention force they provide (Table 2), assisting the clinician in matching attachment strength to abutment number, periodontal support, and desired retention.



Figure 9. Magnetic attachment assembly showing the denture-borne magnet and abutment keeper.

Colour	Approximate Retention Force	Clinical Use
White	Extra-soft (~600 g)	Weak abutments or early adaptation
Pink	Soft (~1,200 g)	Mild retention for initial use
Yellow	Medium (~1,800 g)	Standard retention
Green	Strong (~2,400 g)	Patients needing greater retention
Red	Extra-strong (>2,800 g)	Very high retention, used rarely
Black	Processing cap (non-retentive)	Used only during laboratory pick-up

Table 2. Colour coding and approximate retention force of OT (overdenture) attachment caps.

6.2 Attachments for Implant-Supported Overdentures

Attachments used to link the overdenture to underlying implants may be machine-milled from an alloy or custom cast from a plastic pattern; machine-milled components are generally used on individual implants, whereas custom-cast attachments are favoured for bar designs. The most commonly used systems are ball attachments, Locator attachments, O-ring attachments, Extracoronary Resilient Attachments (ERA), and bar-and-clip systems (Hader and Dolder designs, as described above), with resilient telescopic copings used in selected cases.

As a general treatment-planning principle, patients with significantly resorbed ridges are better candidates for bar or telescopic-coping designs, which offer superior stability, whereas patients with minimal ridge resorption are good candidates for stud or magnetic attachments. Comparative in-vitro evaluation of ball, O-ring, Locator, and ERA attachments has shown that ball attachments provide the greatest retention and stability, followed in descending order by Locator, O-ring, and ERA attachments. Clinical evaluation of Locator attachments placed in the inter-canine region of the atrophic mandible has demonstrated favourable retention and stability, along with improved peri-implant soft-tissue health and easier hygiene maintenance compared with several alternative designs.



Figure 10. Attachment systems for implant-supported overdentures: (a) O-ring attachments on implants, (b) attachment-type schematic, (c) radiographic view, (d) locator/ball attachment components.



7. CONCLUSION

Overdentures, whether tooth-supported or implant-supported, have substantially broadened the scope of removable prosthodontics. Their principal biological advantage lies in the preservation of alveolar bone and, in tooth-supported designs, of periodontal proprioception, while the increasing sophistication of attachment systems and, where indicated, implant configurations has made overdentures biomechanically superior to conventional removable prostheses in terms of support, stability, and retention. Tooth-supported overdentures remain a valuable, cost-conscious option wherever periodontally sound natural abutments can be preserved, particularly in young patients and those with a few strategically located teeth of otherwise limited prognosis. Implant-supported overdentures extend these benefits to the fully edentulous patient, and comparative studies indicate that implant-supported designs provide greater masticatory efficiency than tooth-supported overdentures, which in turn outperform conventional complete dentures. Both modalities have been shown to improve patients' quality of life, function, and psychological well-being, and careful patient selection, meticulous abutment or implant preparation, and appropriate attachment selection remain the cornerstones of long-term clinical success.

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ABSTRACT

Accurate assessment of occlusal contacts is essential in restorative and prosthodontic treatment, yet conventional tools like articulating paper and shim stock remain qualitative and examiner-dependent. The T-Scan system offers a computerized alternative, capturing occlusal contact timing, sequence, and relative force distribution through a thin intraoral sensor, enabling objective, real-time analysis. This article aims to provide a detailed overview of the T-Scan system, covering its assembly, sensor, calibration, mechanism, data interpretation, applications, benefits, and limitations. Current evidence supports T-Scan as a valuable adjunct to, rather than replacement for, conventional occlusal analysis, with future software and sensor advances likely to expand its diagnostic value.

Keywords : Occlusion, T-Scan, Digital occlusal analysis, Occlusal contacts, Sensor

INTRODUCTION

For many years, dental professionals have used basic tools like articulating paper, wax records, shim stock, and pressure-indicating paste to assess occlusal contacts. While these tools indicate where teeth make contact, they do not provide information about the force of each contact, the sequence in which they occur, or the duration it takes for the bite to stabilize.

The T-Scan (Tekscan Inc., Boston, USA) is a computerized system for occlusal analysis that aims to address this issue. It features a thin, flexible sensor that patients bite down on, paired with software that captures the location, timing, and relative force of contacts in real time. Rather than relying on a static mark on paper, the clinician can view a dynamic "movie" of the bite, from the first tooth contact to complete closure. This review details the history, components, calibration procedures, operating mechanism, benefits, limitations, applications, and recent advancements of the T-Scan system.

HISTORY

The idea of electronically measuring occlusal force was developed by Dr. William Maness during the early 1980s, who secured a patent for a pressure-sensitive recording sheet that could be linked to a computer. This system was first launched commercially in 1987 under the name T-Scan I, distributed by Tekscan Inc. It represented the initial chairside tool capable of displaying the relative timing and strength of occlusal contacts as an ongoing recording instead of a single static indication.¹

Since then, the system has passed through several hardware and software generations:

- T-Scan I (1987) – the original system, with a thick, single-layer sensor and basic 2-D graphics.
- T-Scan II (1990s) – improved sensor sensitivity and early software upgrades for clearer visual output.
- T-Scan III (2000s) – thinner sensors, faster data capture rate, and 3-D force-versus-time graphics.
- T-Scan 8/9/Novus (T-Scan 10) (2010s–present) – wireless handles, higher-resolution sensels, integration with jaw-tracking and electromyography (EMG) devices, and cloud/software analytics.

Alongside these system upgrades, the sensor film itself has evolved through several "generations," each offering thinner construction, more sensing elements, and better force reproducibility, addressing many of the accuracy concerns raised about the earlier sensors.

COMPONENTS

The T-Scan system consists of the following main parts:

- Disposable sensor sheet – a thin, U-shaped film embedded with a grid of pressure-sensitive elements called "sensels," available in different arch sizes and thicknesses.
- Sensor handle (recording handle) – holds the disposable sensor firmly in the correct position in the patient's mouth and connects it to the computer.
- Computer with T-Scan software – receives the

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raw sensel data and converts it into 2-D and 3-D colour-coded graphics, force-versus-time graphs, and movies of the bite.

- Connecting cable or wireless module – transmits data from the handle to the computer (later generations, such as the Novus system, use wireless connectivity).

- Foot switch (optional) – allows the operator to start and stop the recording without using their hands, keeping the sensor steady in the patient's mouth.



Fig 1. Components of T-Scan

CALIBRATION

Because every patient bites with a different amount of force, the sensor must be calibrated before each recording so that the force values shown are meaningful for that individual, rather than absolute values in Newtons.² Calibration is generally carried out in the following steps:

- The appropriate arch-sized sensor is selected and inserted into the handle.
- The patient is asked to tap or bite firmly one or more times on the sensor; this establishes a reference (maximum) force level for that patient – sometimes called "multi-bite" calibration in newer software.
- The software auto-scales the colour map (usually blue to red, low to high force) against this reference bite, so the displayed forces are expressed as a percentage of the patient's own maximum bite force.

- Calibration is repeated for each new patient and, ideally, for each new sensor sheet, since sensor sensitivity can vary slightly between individual sheets.

Correct calibration is essential; an uncalibrated or poorly calibrated sensor can make a light contact look artificially heavy, or hide an early or heavy contact altogether.

SENSORS

The T-Scan sensor is a resistive, electronic tactile sensor. It consists of two layers of Mylar (polyester film) encasing a screen-printed grid of resistive ink rows and columns. Each intersection of a row and column forms a 'sensel' – the fundamental sensing unit that records both force and time data. T-Scan sensors are available in two sizes: large and small. Large for broad mediolateral and long anteroposterior dental arches and small for thin mediolateral and short anteroposterior dental arches.⁴

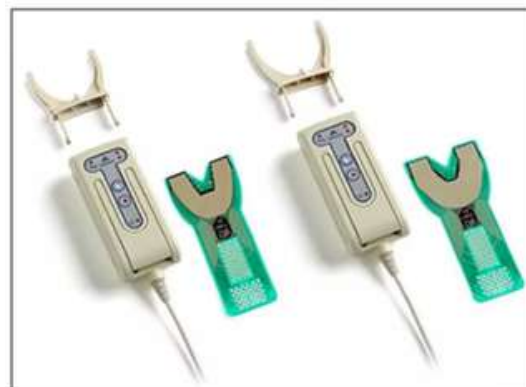


Fig 2. Small and large sensor

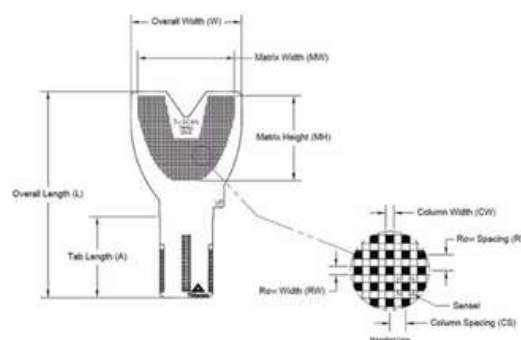


Fig 3. Schematic cross section of sensor

Parameter	Description
Construction	Two layers of Mylar (polyester film) encasing a screen-printed grid of resistive ink rows and columns
Sensel	Each row-column intersection = one 'sensel' (sensing element); records force and time
Sensing principle	Applied occlusal force alters resistance of the ink at each sensel, producing a measurable voltage drop
Shape	Horseshoe/arch-shaped to conform to the dental arch; available in two sizes
Scan rate	Up to 1000 scans/second (0.001-sec intervals) in later systems
Coating	Not coated with articulating ink; saliva-impervious; reusable after alcohol wipe (HD/Novus sensors)
Output	Relative force distribution & timing sequence – NOT an absolute force value unless calibrated

Table 1. Specifications of sensor

Working Principle

- The patient bites onto the horseshoe-shaped sensor positioned over the occlusal/incisal surfaces.
- Occlusal force applied to a sensel compresses the resistive ink layer, altering its electrical resistance.
- This resistance change produces a proportional voltage drop, detected by the connected handle/electronics.
- The hardware supplies current to the sensor, conditions the signal, and performs data acquisition as voltage drops occur across loaded sensels.
- Data is relayed to the software, which displays contact timing (2D) and relative force distribution (3D, colour-coded blue → red).⁵

Key features of sensor

- Force levels: Early sensors recorded 16 levels of relative force; HD/Novus sensors reproduce up to 256 force levels.
- Time resolution: Recording increments as fine as 0.01–0.001 second (up to 1000 scans/sec in newer systems).
- Reusability: HD and Novus sensors are impervious to saliva and can be alcohol-cleaned for reuse on the same patient across visits.
- Measured parameters: Maximum intercuspation, first contact point, occlusion/disocclusion time, percentage force per tooth or per arch side, and centre of force.

Generation	Thickness	Key Feature	Notes
G1 (Blue sensor)	Standard Mylar	Pressure-sensitive ink grid; 16 force levels, 0.01-sec increments	First-generation, arch-shaped
G2	Thinner	Increased flexibility	Improved intraoral comfort
G3	Reduced further	Proprietary Tekscan resistive ink introduced	Improved hysteresis, drift & repeatability
G4 / HD (High Definition)	~100 microns (0.004 in)	Sensel size ↑33%, inactive area ↓50% – sensels packed closer	Used in T-Scan III; reusable, alcohol-cleanable
G5 / Novus HD	~100–105 microns	Most sensitive & thinnest; 256 force levels reproducible ~95% of time	Current generation (T-Scan Novus / v10)

Table 2. Generations of sensor

MECHANISM OF T-SCAN

Once calibrated, the sensor is placed between the patient's arches and the patient is asked to close from an open position into maximum intercuspation (or into their habitual bite), and sometimes to perform lateral and protrusive excursive movements. As the teeth approach and touch the sensor, each sensel generates an electrical signal proportional to the force applied at that location. The software samples this data hundreds of times per second and displays it as:

- A 2-D "footprint" view showing the position of each contact point on the dental arch.
- A colour-coded force scale (commonly blue = light force, green/yellow = moderate force, red = heavy force).
- A 3-D force bar or "movie" that can be played back frame-by-frame to see which tooth contacts first and how contacts are added as the bite closes.
- Numeric outputs such as Occlusion Time (OT – the time from first contact to maximum closure), Disclusion Time (DT – the time taken for posterior teeth to separate during a lateral excursion, leaving only the canine or incisor in contact), and the Center

of Force (COF) trajectory, which tracks the balance of force between the right and left sides of the arch through the bite.³ These time- and force-based measurements are the key advantage of the system over traditional marking materials, which can only record where contact occurred, not when or how hard.

RECORDING

The patient is seated comfortably in upright position with looking forward. The mandible is kept parallel to the floor. The recording handle with the sensor and sensor support is placed into the patient's mouth with the sensor support pointer between the two maxillary central incisors and keeping the scanning handle as parallel to the occlusal plane as possible. The recording is initiated by pressing the button on the recording handle. The patient is asked to close the mouth till complete intercuspation is reached, without making any excursive movements. After the handle button is pressed the arch model is automatically created on the screen.

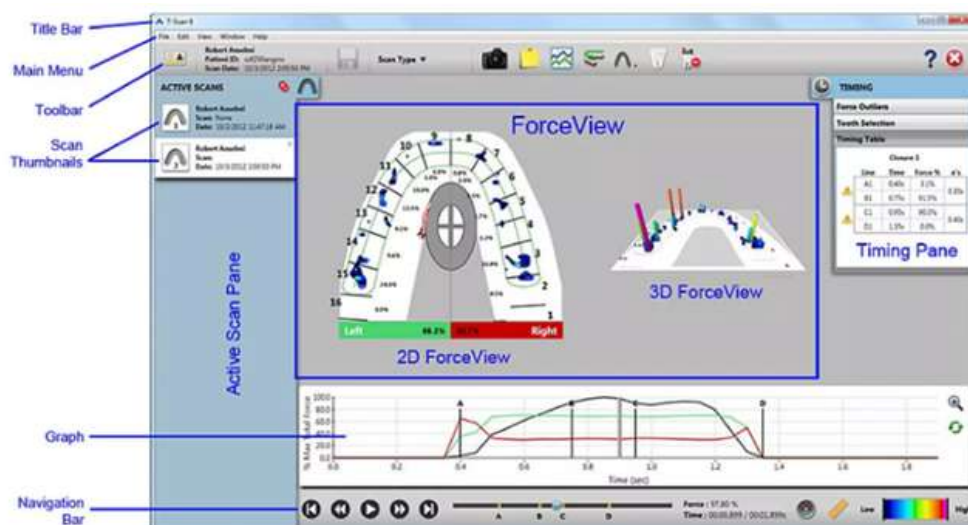


Fig 4. T scan multi bite screen capture

APPLICATIONS

- **Diagnostic screening:** Natural dentition with occlusal disturbance or occlusal trauma is the reason of many pathologies in the mouth. T-scan acts as valuable tool in diagnosing occlusal trauma.
- **Patient education** (treatment acceptance, improve longevity, enhanced comfort, eliminate extra visits), occlusal diagnosis and equilibration.
- **Prosthodontics:** Replacement of single or multiple teeth with crown, bridge, complete or partial denture, used as a diagnostic screening method for occlusal stability in intercuspatal position and occlusal balancing.
- **Implantology:** Dental implants may deteriorate under excursive overload and higher bite forces, eventually leading to bone loss and implant failure. T-Scan shows in thousands of a second time intervals how force is applied to adjacent teeth and implants.
- **Temporomandibular Disorders:** The application of T-Scan and kinesiographic techniques in combination with electromyography is used to locate certain factors such as chronology and strength of contact points, muscular activity, or certain mandibular movements
- **Case Finishing:** As articulating paper does not measure force, balance, or timing, it is not a media to rely on. T-Scan allows a clinician to case finish with accuracy and confidence.
- **Orthodontics:** The use of T-scan before and after orthodontic treatment for every patient

helps to attain the goal of correcting malocclusion and maintaining the proper bite force. Restorative dentistry: T-Scan rule out over/under restored tooth and saved the time of finishing restoration and recall visits.

ADVANTAGES

- Provides objective, quantifiable, and reproducible data rather than a subjective ink mark.
- Records the timing of occlusal contacts in milliseconds, showing the true sequence of tooth contact.
- Displays relative force distribution and percentage loading at each tooth, and calculates Occlusion Time and Disclusion Time.
- Captures dynamic (movement-based) occlusion, not only a static bite, through video-style playback.
- Tracks the Center of Force and can reveal right-left force imbalance that is difficult to detect clinically.
- Serves as a visual biofeedback and patient-education tool, since patients can see their own bite pattern on screen.
- Useful chairside guide for selective occlusal adjustment/equilibration, and for verifying occlusion on fixed, removable, and implant-supported prostheses.
- Non-invasive, relatively quick to use once the operator is trained, and the sensor handle itself is reusable across patients (only the sensor sheet is single-use).⁷

DISADVANTAGES

- The disposable sensor sheets are single-use and add a recurring cost to every recording.
- The sensor has a measurable thickness; even though it is thin, it can slightly alter the natural occlusal contact pattern compared with an unencumbered bite.
- Older sensor generations were prone to force plateauing or "saturation" at high bite forces, and to gradual wear/tear with repeated use.
- Output largely represents relative force as a percentage rather than a true absolute value in Newtons for early systems, so results must be interpreted with this in mind.
- Requires calibration for every patient and ideally for every new sensor, adding chair-time and a learning curve for new operators.
- Equipment and per-patient sensor costs are relatively high compared with conventional articulating paper or wax.

RECENT ADVANCES IN OCCLUSAL ANALYSIS

- T-Scan Novus (T-Scan 10) — a wireless system with a higher-resolution sensor grid and improved software analytics, aiming to reduce earlier concerns about sensor saturation and reproducibility.⁶
- Combined-technology protocols that pair T-Scan with jaw-tracking and surface electromyography (EMG) devices to correlate occlusal timing/force data with muscle activity, particularly in TMD and bruxism management. (for example Modjaw)
- Comparative research evaluating T-Scan against intraoral-scanner occlusion modules (for example, Medit and CEREC systems), examining whether optical scanning can complement or partly replace pressure-sensor-based occlusal analysis.
- Use of T-Scan to monitor occlusal load changes in 3-D printed occlusal splints over time in bruxism patients, supporting digital workflows in splint therapy.
- OccluSense is a wireless digital occlusal analysis system by Bausch (Germany) that uses a thin, 60-micron pressure sensor to record static and dynamic occlusal contacts in up to 256 pressure levels, transmitting data to an iPad app for 2D/3D visualization.⁸
- Growing interest in integrating occlusal force/timing data with CAD-CAM design workflows and, increasingly, software-assisted pattern analysis to help interpret force-distribution data more objectively.

DISCUSSION

The T-Scan adds a dimension to occlusal examination — force and time — that conventional marking media cannot capture, and this has made it a useful adjunct in TMD management, prosthodontic occlusal verification, and orthodontic finishing. At the same time, the literature is mixed on absolute accuracy, and results can vary between sensor generations and study protocols, so T-Scan findings are best used to complement, rather than replace, careful clinical examination and conventional occlusal indicators.

A comparison with other current occlusal analysis approaches helps place the T-Scan in context. Articulating paper and shim stock remain inexpensive and simple but are purely qualitative. Intraoral optical scanners can now generate virtual occlusion maps from digital impressions, offering a metal- and paper-free workflow, but they typically capture a static bite rather than the dynamic sequence and timing that the T-Scan provides. Ongoing improvements in sensor technology, wireless connectivity, and integration with EMG/jaw-tracking systems are gradually addressing earlier criticisms, and the growing number of systematic reviews suggests the evidence base is maturing, though larger standardized clinical trials are still needed.

CONCLUSION

The T-Scan system has evolved over more than three decades from a simple pressure-sensitive sheet into a sophisticated digital occlusal analysis tool capable of recording contact location, timing, and relative force in real time. It offers clear advantages in objectivity, patient communication, and guided occlusal adjustment, while its main limitations remain sensor cost, calibration requirements, and residual questions about absolute accuracy. Used thoughtfully alongside sound clinical judgment and conventional occlusal indicators, the T-Scan is a valuable adjunct across restorative dentistry, prosthodontics, orthodontics, and TMD/bruxism management, and continues to develop in step with the broader digital dentistry workflow.

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CURRENT CONCEPTS IN THE DIAGNOSIS AND MANAGEMENT OF DENTINAL HYPERSENSITIVITY

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ABSTRACT

Dentinal hypersensitivity is characterized by a short, sharp pain arising from exposed dentin in response to various external stimuli in the absence of other dental pathology. It commonly occurs due to loss of enamel or cementum from abrasion, erosion, attrition, gingival recession, or periodontal therapy, leading to exposure of dentinal tubules. The hydrodynamic theory is the most widely accepted mechanism explaining the pain response. Diagnosis is primarily clinical and requires exclusion of other causes of dental pain. Management involves identification and elimination of etiological factors, patient education, and a stepwise approach using at home desensitizing agents and professionally applied in office therapies. Recent advances such as laser application and bioactive remineralizing materials show promising results in providing long term symptoms relief. This review outlines current concepts in the diagnosis and management of dentinal hypersensitivity to support effective clinical practice

Key Words: Dentinal hypersensitivity, Diagnosis, Hydrodynamic theory, Desensitizing agents, Tubule occlusion.

INTRODUCTION

Dentinal hypersensitivity (DH) is one of the most prevalent clinical conditions affecting permanent teeth. It is characterized by a short, sharp pain arising from exposed dentin in response to external stimuli following the loss of enamel and/or cementum.^{1,2} The reported prevalence of DH ranges from approximately 8% to 57%, reflecting variations in study populations and diagnostic criteria.⁷ Although common, its diagnosis remains challenging because its clinical presentation often resembles that of other dental conditions.¹² Therefore, accurate differential diagnosis is essential to ensure appropriate management and effective treatment.¹² This review provides a comprehensive overview of the etiology, epidemiology, pathophysiology, clinical presentation, diagnostic approaches, and current treatment strategies for dentinal hypersensitivity, thereby assisting clinicians in establishing an accurate diagnosis and management.¹

TABLE 1: COMMON TERMS WHICH ARE USED TO REFER DENTINE HYPERSENSITIVITY

Dentine Sensitivity
Dentine Hypersensitivity
Dentinal Hypersensitivity
Cervical Hypersensitivity/Sensitivity
Root Hypersensitivity/Sensitivity
Cemental Hypersensitivity/Sensitivity

DEFINITION

The condition has been defined by an international workshop on DH as follows:

“Dentine hypersensitivity is characterized by short sharp pain arising from exposed dentine in response to stimuli, typically thermal, evaporative, tactile, osmotic, or chemical and which cannot be ascribed to any other dental defect or pathology.”⁵

PREVALENCE AND EPIDEMIOLOGY

The reported distribution and clinical presentation of the disease vary across different studies.^{1,7} These variations may be attributed to differences in population characteristics, lifestyle, habits, dietary patterns, and research methodologies.¹ Several studies have identified DH among adult populations with reported prevalence ranging from (5% to 85%) and 2% to 74% respectively.^{1,7}

DH is slightly more common in females than in males. Although it can occur at any age, it is most frequently seen in individuals between 20 and 50 years, with the highest occurrence between 30 and 40 years of age.¹ Among the teeth affected, canines and premolars in both arches are most commonly involved. The cervical region on the buccal surface is the site most frequently affected.⁶

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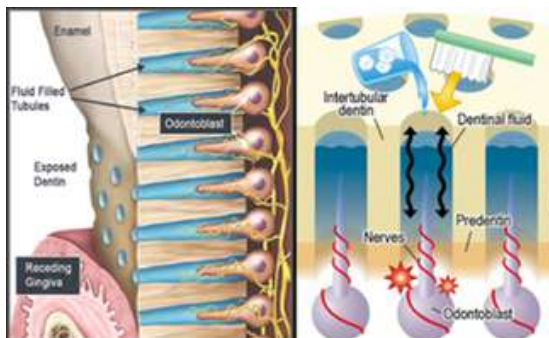
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ETIOPATHOGENESIS

Anatomy of the tooth and the dentin -pulp complex

Dentin is regarded as a vital tissue because it has the ability to respond to both physiological and pathological stimuli.² In the crown portion of the tooth, dentin is covered by enamel, while in the root it is protected by a thin layer of cementum.^{2,6} Despite this protective covering, dentin remains inherently sensitive.²

This sensitivity is primarily due to the presence of odontoblastic processes and the structural relationship between dentin and pulp collectively known as the dentin - pulp complex.^{2,6} Although dentin and pulp are histologically distinct tissues, they share a common embryological origin from the ectomesenchyme. Because of this close developmental and structural relationship, changes occurring in one tissue can directly influence the other.²



Dentin contains numerous microscopic tubules that extend from the pulp to the dentinoenamel junction. These tubules house extensions of odontoblast, which are principal cells of the pulp responsible for dentin formation. The odontoblastic processes run through the entire thickness of dentin and are surrounded by dentinal fluid within the tubules.

Dentinal fluid accounts for approximately 22% of total volume of dentin. It is an ultrafiltrate derived from the pulpal blood vessels and serves as a communication medium between the pulp and the outer dentin. Through this fluid filled tubular system, stimuli applied to

exposed dentin can be transmitted to the pulp, explaining the vital and sensitive nature of dentin.

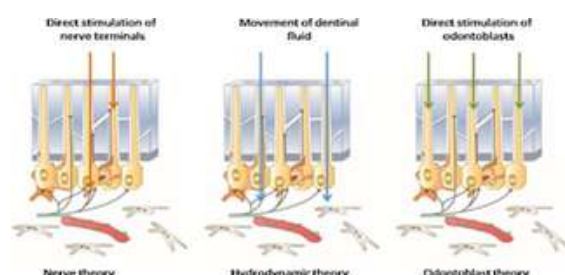
Thus, the intimate structural and functional interrelationship between dentin and pulp forms the basis of the dentin-pulp complex and plays a key role in the pathogenesis of dentinal sensitivity.^{2,3}

PATHOGENESIS

Dentinal hypersensitivity develops in two stages:^{2,6}

- (1) Lesion localization
- (2) Lesion initiation

Initially protective enamel or cementum is lost due to attrition, abrasion, erosion, abfraction, gingival recession or dental procedures leading to exposure of dentinal tubules -commonly in canines and premolars.^{1,6} However the exposed dentin does not always result in sensitivity.² Sensitivity occurs when the protective smear layer and tubular plugs are removed, increasing dentinal fluid movement and stimulate pulpal nerves.^{2,3} These plugs, formed from salivary proteins and calcium phosphate deposits, temporarily seal the tubules but can be dislodged by mechanical forces and acidic foods or drinks.⁶ Microbial plaque appears to have a minimal role in triggering dentinal hypersensitivity.¹ anaesthetic to dentin does not effectively block pain.²



2) Odontoblastic receptor theory

According to this theory, odontoblasts act as receptors and transmit signals to pulp nerves. However, odontoblasts are primarily matrix-forming cells and are not considered excitable. No synaptic connection has been demonstrated between odontoblasts and nerve fibres, so this theory is also largely unsupported.²

3) Hydrodynamic theory (most accepted theory)

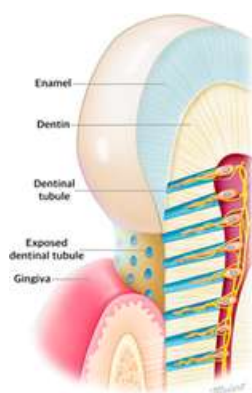
Proposed by Brannstrom, this theory states that pain results from fluid movement within the dentinal tubules, thermal, mechanical, or osmotic stimuli cause fluid shift, which stimulates nerve endings in the pulp or dentin pulp complex.^{2,3}

- cooling, drying, evaporation and hypertonic solutions cause outward fluid movement, increasing pain
- heating causes inward fluid movement
- Approximately 75% of patients experience pain in response to cold stimuli.

Hypersensitive dentin has a greater number of tubules (up to eight times more) and wider tubules compared to non-sensitive dentin, leading to increased fluid movement and greater pain response.^{2,3}

CAUSES

DH is a multifactorial condition primarily initiated by the loss of protective mineralised tissues—enamel or cementum—resulting in the exposure of underlying dentinal tubules.^{1,6}



mechanical wear: Attrition (masticatory or parafunctional wear such as bruxism) and Abrasion (mechanical wear from foreign objects notably aggressive tooth brushing techniques or highly abrasive dentifrices)^{1,7}

•chemical erosion: The nonbacterial dissolution of tooth structure occurs via intrinsic acids (e.g. - gastric reflux/GERD) or extrinsic acids (e.g. dietary acids and environmental exposure)⁶

•periodontal changes: Gingival recession or orthodontic movement^{6,7}

•Gingival recession is due to root prominence and thin overlying mucosa

•dehiscence and fenestration

•frenum pulls

•orthodontic movement

•bleaching - the sensitivity associated with vital tooth bleaching is clinically classified as a transient reversible pulpitis. This pain driven by the rapid penetration of peroxide-based agents through enamel and dentin reaching the pulp chamber within minutes of application, symptoms typically resolve spontaneously upon the cessation of the bleaching treatment.⁷

•periodontal treatment- while periodontal therapy is essential for managing disease and preserving aesthetics. It frequently results in postoperative dentin hypersensitivity. This sensitivity occurs when treatment reduces the protective gingival barrier or when scaling and root planing removes 20 to 50 µm of cementum

DIAGNOSIS

Dentin hypersensitivity is a diagnosis of exclusion^{4,5} and requires careful differentiation from other causes of dental pain such as caries, cracked or fractured tooth, defective restoration, reversible or irreversible pulpitis, post-bleaching sensitivity, occlusal trauma, periodontal disease and other endodontic conditions.⁴ A thorough history and clinical examination are essential for accurate diagnosis. Patients with DH typically report a short, sharp, well-localized pain triggered by stimuli such as cold, air, touch, osmotic or chemical agents, and the pain usually subsides immediately once the stimulus is removed. Lingering or spontaneous pain generally indicates pulpal inflammation rather than DH.^{4,5}

A proper diagnosis begins with a detailed history and clinical examination. Important aspects of history includes:

- onset and duration of pain
- nature and intensity of pain
- triggering factors(cold,touch,air, osmotic or chemical stimuli)
- whetherpain disappears immediately after removal of stimuli

CLINICAL EXAMINATION

Clinical examination involves visual and tactile assessment for exposed dentin.use of an air blast or water spray to reproduce symptoms gentle probing of cervical areas, percussion and palpation tests to rule out periodontal or pulpal involvement,bite tests and transillumination to detect cracks and radiographic evaluation to exclude caries or periapical pathology.pain intensity may be assessed using categorical scale or a visual analogue scale although patient reported perception remain central to diagnosis.⁴

MANAGEMENT

Effective management of DH begins with identification and elimination of predisposing and etiological factors as treatment without addressing the cause often provides only temporary relief.^{7,11}Common contributing factors include improper or aggressive tooth brushing,use of hard toothbrushes or abrasive toothpaste, brushing immediately after consuming acid foods or beverages, gingival recession, periodontal therapy leading to root exposure, high dietary acid intake, gastric reflux, eating disorders, xerostomia, occlusal trauma and tobacco use.

(Classification and therapeutic approaches)

• Classification of desensitizing agents

Desensitizing agents used in the management of DH may be classified according to (1) mode of administration and(2) mechanism of action

Based on mode of administration, agents are categorised as:

(1) At home (self-applied) therapies - simple cost-effective modalities suitable for sensitivity involving multiple teeth⁷

(2) In office (professionally applied) therapies - more technique sensitive and comparatively expensive procedures, generally indicated for localised or severe hypersensitivity.

Based on mechanism of action, desensitizing agents function by

- 1) interfering with neural transmission and reducing nerve excitability.
- 2) occluding dentinal tubules and decreasing dentinal fluid movement, consistent with the hydrodynamic theory.

An ideal desensitizing agent agent should:

- act rapidly
- provide long lasting relief
- easy to apply
- cause no pulpal irritation or tooth discoloration
- be safe and cost effective
- maintain sustained clinical effectiveness.

At home desensitizing therapies

At home treatments include desensitizing toothpaste,mouthrinses and chewing gums. These agents typically require consistent use for 2-4 weeks to achieve measurable reduction in sensitivity.

Potassium Salts

Potassium nitrate, potassium chloride and potassium citrate are widely used in dentifrices. These compounds reduce nerve excitability by increasing extra cellular potassium ion concentration around pulpal nerve fibres, thereby interfering with depolarisation, clinical studies have demonstrated significant reduction in DH with potassium - containing toothpaste when used regularly with soft bristled toothbrushes.⁷

Fluorides

Fluoride- containing dentrifices and mouthrinses reduce dentin permeability by promoting precipitation of calcium fluoride crystals within dentinal tubules. sodium fluoride and stannous fluoride are the most commonly used formulation fluoride may also enhance remineralization of enamel and dentin. some formulations are acidulated to improve ionic penetration ⁶

Arginine based formulations (proargin technology)

Arginine - containing dentrifices utilise the natural buffering capacity of salivary. Arginine (a positively charged amino acid) in combination with calcium carbonate and fluoride, promotes deposition of calcium and phosphate rich precipitates within exposed dentinal tubules. This occlusion has been shown to provide rapid relief and resistance to acidic challenges ⁷

Casein phosphopeptide -Amorphous calcium phosphate (CPP-ACP)

CPP-ACP, derived from milk casein, stabilizes bioavailable calcium and phosphate ion and promotes remineralization. It facilitates mineral deposition within dentinal tubules and has demonstrated effectiveness in reducing DH by enhancing surface mineral density.⁹

Oxalates

Potassium oxalate formulation reduce dentin permeability by forming calcium oxalate crystals within dentinal tubules. Although effective in short term occlusion, their long-term durability may be limited due to potential crystal dissolution.⁶

In office desensitizing therapies

In office therapies are generally indicated when at home treatment fail to provide adequate relief.⁷

Fluoride varnishes and gels

Topical fluoride varnishes (eg 5% sodium fluoride) create a calcium fluoride precipitate on the dentin surface, forming a protective barrier that reduces permeability, clinical

studies report significant reduction in hypersensitivity lasting several weeks to months after a single application.⁷

Adhesive system and Dentin Bonding Agents
Resin based adhesive systems forms a hybrid layer by infiltrating etched dentin and sealing tubules with resin tags. newer bonding agents modify the smear layer rather than completely removing it, improving tubule sealing and/ providing longer term relief.³

Glutaraldehyde Based Agents

Desensitizers containing glutaraldehyde and hydroxyethyl methacrylate (HEMA) act by coagulating serum proteins within dentinal tubules, forming insoluble precipitates that occlude tubules. polymerization of HEMA further enhances sealing.⁶

Bioglass and calcium phosphate compounds
Bioactive glass formulations release calcium and phosphate ions, promoting formation of an apatite like layer that occludes dentinal tubules. Similarly, calcium phosphate precipitates system encourage remineralization and tubule blockage.⁹

Portland cement derivatives

Calcium silicate based materials derived from portland cement have been reported to promote remineralization and occlusion of dentinal tubules.

Oxalate desensitizers

Professional oxalate treatments produce calcium oxalate crystal deposition within tubules. Some formulation may influence bonding strength when used prior to adhesive procedures

Laser therapy

Various laser systems, including Nd:YAG, Er:YAG, and GA Al As lasers, have been employed in DH management. proposed mechanism include:⁸

- protein coagulation within dentinal tubules
- partial melting and recrystallization of dentin
- reduction of neural transmission

Laser therapy has demonstrated variable effectiveness depending on wavelength, energy parameters, and application technique. While generally well accepted by patients, further long term studies are needed.

Iontophoresis

This technique uses electric current to enhance penetration of fluoride ions into dentinal tubules, improving desensitizing effects compared to topical application alone.⁶

Additional Approaches

Sealants and resin coatings

Surface sealants composed of methacrylate resins and other bonding agents provide immediate tubule occlusion and are useful for localised hypersensitivity.

Glass ionomer materials

Resin modified glass ionomers have shown effectiveness in reducing root sensitivity by infiltrating and sealing exposed dentin surfaces.

Recent advances

Newer approaches focus on biomimetic and mineralising materials such as calcium silicate - based compounds, which promote long term tubule occlusion and reduced dentin permeability. Phytocomplexes derived from plant sources have also demonstrated potential by inducing crystal formation within dentinal tubules.⁹

Preventive Recommendation

1) modify brushing habits⁷

- use soft toothbrush
- avoid excessive force
- avoid abrasive toothpaste
- brush before meals rather than immediately after acidic intake
- wait at least one hour after acidic food before brushing

2) control dietary acids⁶

- reduce frequency of acidic foods/drinks
- use straw for acidic beverages
- avoid swishing acidic drinks

- rinse with water or milk after acidic intake

3) manage endogenous acids

- refer patients with gastric reflux or eating disorders for medical care

4) correct occlusal problems

- occlusal adjustment or splints if necessary

5) manage gingival recession⁷

- periodontal consultation
- possible graft or flap procedures

Poor oral hygiene leading to periodontal disease may increase root exposure and worsen DH

Clinical management strategy

Effective management of dentin hypersensitivity involves;

- 1) Identification and elimination of etiological factors (eg:- abrasion, erosion, gingival recession)
- 2) Initiation of at home therapy for mild to moderate cases
- 3) Escalation to in- office interventions if symptoms persist after 2-4 weeks.
- 4) Consideration of restorative procedures or endodontic treatment in refractory cases.
- 5) Emphasis on patient education, including proper brushing technique and dietary counselling.

CONCLUSION

DH is a multifactorial condition primarily explained by the hydrodynamic theory.^{2,3} contemporary management strategies focus on either reducing neural excitability or occluding dentinal tubules.⁷ A stepwise, minimally invasive approach beginning with at home therapies and progressing to professional intervention remains the most rational and evidence-based method for achieving sustained symptom relief.¹¹ Although numerous materials are available, long term success depends on accurate diagnosis, appropriate treatment selection and patient compliance.

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Oral Health-Related Quality of Life in the Elderly: A Narrative Review of Determinants, Impact, and Strategies for Improvement

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ABSTRACT

Oral health-related quality of life (OHRQoL) is a multidimensional construct that reflects the functional, psychological, and social impact of oral conditions on well-being, and it is disproportionately affected in the geriatric population. This review synthesises evidence from cross-sectional surveys, systematic reviews, and an umbrella review addressing OHRQoL in elderly cohorts across Europe, the Middle East, and multiple continents. Dental caries, periodontal disease, edentulism, xerostomia, and oral cancer remain highly prevalent among older adults [3,6] and are consistently associated with impaired mastication, nutritional compromise, and psychosocial withdrawal. Instruments such as the Oral Health Impact Profile (OHIP-14/49) and the Geriatric Oral Health Assessment Index (GOHAI) demonstrate that OHRQoL scores are generally suboptimal, with institutionalised and home-bound elderly faring worse than community-dwelling counterparts [1,2,5]. Xerostomia, subjective memory impairment, negative self-perceived dental status, living alone, low income, and lack of dental insurance emerge as consistent predictors of poor OHRQoL [1,2,7], while the presence of a functional dental prosthesis is associated with better outcomes [8]. Barriers to dental care access—cost, fear, limited perceived need, and system-level fragmentation—further compound the problem [3]. A coordinated, multidisciplinary approach integrating preventive oral health education, subsidised care, tele-dentistry, and caregiver training is warranted to improve the OHRQoL of the ageing population.

Keywords: oral health-related quality of life; elderly; geriatric dentistry; edentulism; xerostomia; OHIP-14; GOHAI

1. INTRODUCTION

The global population aged 60 years and above is expanding rapidly, rising from approximately 12% of the world's population in 2015 and projected to reach 22% by 2050 [2]. This demographic transition brings oral health to the forefront of geriatric care, since ageing is accompanied by a cumulative burden of dental caries, periodontal disease, tooth loss, xerostomia, and oral mucosal pathology [3,6]. Oral health is no longer viewed merely as the absence of disease; the World Health Organization frames it as integral to overall well-being, encompassing the ability to eat, speak, and socialise without pain or embarrassment [6,8].

Oral health-related quality of life (OHRQoL) captures this broader impact by measuring how oral conditions affect physical function, psychological state, and social participation [4,6]. In the elderly, OHRQoL is shaped not only by clinical dental status but by systemic comorbidity, cognitive status, living

arrangements, socioeconomic position, and access to dental services [2,5,7]. This review synthesises evidence from eight recent publications—including population surveys, a meta-analysis, an umbrella review, and a narrative review—to characterise the burden of oral disease in older adults, examine the determinants of OHRQoL, and outline strategies to mitigate this burden.

2. METHODOLOGY

This narrative review synthesises data from eight peer-reviewed sources published between 2015 and 2024, comprising cross-sectional surveys, a systematic review with meta-analysis, an umbrella review of systematic reviews, and narrative reviews addressing oral health and OHRQoL in populations aged 60 years and above. Studies were drawn from Spain, Germany, Romania, Italy, Iran (multinational meta-analysis), and Saudi Arabia, collectively representing more than 24,000 older adults across community, home-based care, and institutional settings. A summary of the included sources is presented in Table 1.

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Study (Year)	Design / Population	OHRQoL Tool	Key Finding
Paredes-Rodríguez et al. (2016) [1]	Cross-sectional; n=30 institutionalised elderly, Spain	OHIP-14	Xerostomia (not tooth number or drug count) significantly correlated with poorer QoL (r=0.68)
Koenig et al. (2024) [2]	Cross-sectional survey; n=1,622 home-based care recipients, Germany	OHIP-G14	Negative self-rated dental status, need for oral-care support, living alone, and subjective memory impairment predicted poorer
Janto et al. (2022) [3]	Narrative review; 122 sources	Various	Caries, periodontal disease, edentulism, oral cancer and xerostomia jointly drive nutritional deficit and reduced
Ferrillo et al. (2024) [4]	Umbrella review; 3 systematic reviews	OHIP-14/49, GOHAI	Frailty is closely linked to poor OHRQoL; malnutrition–social isolation–oral health form a reinforcing cycle
Azami-Aghdash et al. (2021) [5]	Systematic review & meta-analysis; 48 studies, 22,416 elderly, 26 countries	GOHAI, OHIP-14, OHIP-49	OHRQoL was suboptimal overall; lowest in nursing homes, best in community-dwelling elderly
Gil-Montoya et al. (2015) [6]	Nonsystematic review; 81 articles	OHRQoL/HRQoL concept review	Periodontitis linked to diabetes, cardiovascular disease and dementia; edentulism impairs mastication and nutrition
Al Shammary (2024) [7]	Cross-sectional; n=586, Saudi Arabia	OHQoL-UK®	Lower income, no health insurance, and lower education were associated with poorer OHRQoL
Alshammari et al. (2018) [8]	Cross-sectional; n=200 edentulous elderly, Saudi Arabia	GOHAI-Ar	Presence of a dental prosthesis was positively associated with OHRQoL; poor OHRQoL was prevalent overall

3. BURDEN OF ORAL DISEASE IN THE ELDERLY

3.1 Dental Caries

Caries prevalence remains high in older adults owing to salivary changes, gingival recession exposing root surfaces, xerostomia secondary to polypharmacy, and increasing retention of natural teeth into old age [3,6]. Global estimates of caries prevalence in community-dwelling elderly range from 25% in Australia and the United States to as high as 98–99% in China and South Africa, with root caries prevalence reaching up to 62% in China [3]. The shift toward minimally invasive, remineralising approaches rather than extraction reflects an effort to preserve natural dentition and associated function [6].

3.2 Periodontal Disease

Periodontal disease was ranked the 11th most prevalent condition worldwide in the Global Burden of Disease Study, and while its incidence in the elderly is comparatively low, the prevalence of severe periodontitis rises steadily with age [3]. Dysbiosis of the subgingival microbiome, dominated by pathogens such as *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola*, underlies disease progression toward attachment loss and eventual tooth loss [3]. Periodontitis has also been implicated as a risk factor for cardiovascular disease, diabetes, and cognitive decline through inflammatory, bacterial, and vascular pathways [6].

3.3 Edentulism and Tooth Loss

Edentulism represents the end-stage consequence of untreated caries and periodontal disease and remains highly prevalent, ranging from approximately 22% in the United States to over 39% in New Zealand among adults over 74 years, with considerable international variation attributable to differences in access to dental care and public financing [3,6]. Tooth loss compromises masticatory efficiency, alters dietary choices toward softer, less nutrient-dense foods, and has been linked to increased all-cause mortality in several longitudinal cohorts [3,6]. In edentulous elderly populations specifically, the presence and type of dental prosthesis significantly influences OHRQoL, with fixed and well-fitting removable prostheses associated with better psychological and functional domain scores than an absence of prosthetic rehabilitation [8].

3.4 Xerostomia

Xerostomia affects 12–28% of community-dwelling elderly, rising to 40–60% among institutionalised individuals, principally as a consequence of polypharmacy—over 400 medications are recognised to reduce salivary flow [1]. In a Spanish cohort of institutionalised elderly, xerostomia (rather than the number of remaining teeth or medications taken) was the single factor significantly associated with poorer OHIP-14 scores ($r = 0.68$) [1]. Management remains largely palliative, relying on hydration, sugar-free saliva stimulants, and avoidance of xerogenic triggers, since pharmacological sialogogues show limited efficacy [6].

3.5 Oral Cancer

Oral cancer, comprising lip, oral cavity, and pharyngeal malignancy, is the eighth most common cancer worldwide and disproportionately affects older men, with treatment complexity increased by comorbidity burden in this age group [3,6]. Post-operative complication and infection rates are higher in elderly patients, and functional losses in speech, swallowing, and mastication following treatment substantially reduce quality of life, underscoring the need for individualised, multidisciplinary management [3].

4. MEASURING ORAL HEALTH-RELATED QUALITY OF LIFE

Two instruments dominate the OHRQoL literature in geriatric populations. The Oral Health Impact Profile (OHIP), available in 49-item and abbreviated 14-item forms, evaluates seven dimensions—functional limitation, physical pain, physical disability, psychological discomfort, psychological disability, social disability, and handicap [1,2]. The Geriatric (General) Oral Health Assessment Index (GOHAI) is a 12-item index assessing physical function, psychosocial function, and pain/discomfort, and has been validated in numerous languages including Arabic, German, Hindi, and Persian [8].

A meta-analysis pooling 48 studies and 22,416 elderly participants across 26 countries reported markedly poorer OHRQoL among nursing-home residents (GOHAI additive mean 72.6) compared with community-

dwelling elderly (GOHAI additive mean 83.0), with health-centre attendees falling in between (79.3) [5]. Similarly, OHIP-14 additive scores were highest (indicating greater impact) in home/community settings relative to health-centre populations, reflecting instrument- and setting-specific variation that complicates direct cross-study comparison [5]. In home-based care recipients in Germany, 40% reported at least one oral health impact [2], while a Saudi cross-sectional study using GOHAI-Ar reported a mean score of 27.68 out of 60, indicative of considerable impairment, particularly among edentulous participants [8].

5. DETERMINANTS OF OHRQOL IN OLDER ADULTS

5.1 Clinical and Dental Factors

Contrary to intuitive expectation, several studies found no significant correlation between the number of remaining teeth and overall OHRQoL^[1], suggesting that subjective oral symptoms—particularly xerostomia and denture-related discomfort—may outweigh purely numerical measures of dentition. Conversely, prosthodontic rehabilitation status, denture-related pain, ulceration, and malodour were significantly correlated with poorer physical, psychological, and overall GOHAI scores in an edentulous Saudi cohort^[8], and periodontal disease and DMFT (decayed, missing, filled teeth) indices were independently associated with poorer OHRQoL in a large meta-analytic synthesis^[4].

5.2 Systemic and Cognitive Factors

Frailty, malnutrition, and cognitive decline form an interlinked triad with poor oral health. An umbrella review of systematic reviews concluded that frailty is closely correlated with reduced OHRQoL, proposing a self-reinforcing 'malnutrition–disability cycle' in which poor dentition limits dietary intake, accelerating sarcopenia and further functional decline^[4]. Subjective memory impairment was independently associated with greater severity of oral health impacts in the German InSEMaP cohort ($\beta = 2.6$, $p < 0.001$)^[2], while periodontal inflammation has been proposed as a contributory mechanism in vascular cognitive decline and Alzheimer's disease via systemic inflammatory mediators^[6].

5.3 Psychosocial and Socioeconomic Factors

Living alone, lower educational attainment, absence of health insurance, and lower household income were consistently linked to poorer OHRQoL across studies from Germany and Saudi Arabia [2,7]. In the Saudi cross-sectional study of 586 participants, OHRQoL scores were significantly influenced by education level, monthly income, and health insurance coverage, with regression coefficients indicating that lower educational attainment was associated with substantially poorer scores across nearly every OHRQoL subscale^[7]. Gender differences were also observed, with male participants reporting significantly better GOHAI and pain/discomfort scores than females in the Saudi edentulous cohort^[8].

5.4 Care Setting

Care setting exerts a strong and consistent influence: institutionalised and home-bound elderly report worse OHRQoL than community-dwelling peers^[5], attributable to reduced motivation, diminished social interaction, restricted access to routine dental review, and a higher burden of comorbidity and dependency^[2,5]. Needing support for daily oral care and having a designated caregiver for oral hygiene were both independently associated with poorer OHRQoL severity scores in the German cohort, even after adjustment for other variables^[2].

6. ORAL HEALTH, NUTRITION, AND GENERAL WELL-BEING

Impaired mastication secondary to tooth loss or ill-fitting prostheses drives a shift toward softer, less nutritious diets low in fibre, protein, and micronutrients, increasing the risk of malnutrition, sarcopenia, and consequent frailty^[3,6]. This relationship is bidirectional: malnutrition itself impairs mucosal healing and immune competence, exacerbating oral disease progression^[4]. Reviews of nutritional surveys in the UK and United States (NDNS and NHANES) demonstrate that edentulous individuals, particularly those without adequate prosthetic replacement, consume fewer fruits and vegetables and a higher proportion of refined carbohydrates^[6]. Beyond nutrition, poor oral

health has been associated with increased all-cause and cardiovascular mortality, aspiration pneumonia risk, and diminished self-esteem due to embarrassment about appearance or halitosis, which in turn fosters social withdrawal and isolation [3,4,6].

7. BARRIERS TO DENTAL CARE ACCESS

Utilisation of dental services among the elderly remains low relative to need. Identified barriers operate at active, passive, and systemic levels [3], as summarised in Table 2. In a study of 39 elderly participants and their caregivers, fear of

treatment, cost, and limited availability or accessibility of services were the principal active barriers, while a simple lack of perceived need—especially among edentulous individuals who no longer feel 'at risk'—represented the dominant passive barrier [3]. Financial constraints are compounded by wide variation in dental insurance coverage internationally, ranging from near-universal coverage in Germany (98%) to markedly lower rates in the United States (48%), Spain (31%), and Switzerland (21%) [3].

Barrier Type	Barrier Type	Proposed Mitigation
Active / patient-level	Fear of treatment, cost of care, poor availability and accessibility of dental services, dentist characteristics	Subsidised or insured dental care; flexible appointment timing and location; workforce training in geriatric dentistry
Passive / perceptual	Lack of perceived need for care, especially among edentulous individuals	Public oral-health education campaigns; routine screening embedded in general health/care-level assessments
Systemic / policy-level	Absence of national geriatric oral-health policy, fragmented dental-medical care pathways, limited insurance coverage	Integration of oral health screening into primary/geriatric care; tele-dentistry; mobile dental units; caregiver training

8. STRATEGIES TO IMPROVE ORAL HEALTH AND OHRQOL

A range of individual-level and system-level interventions have demonstrated benefit:

- Structured oral hygiene education for patients and caregivers, including denture care and mucosal cleaning instructions, has been shown to significantly reduce dental plaque and improve denture cleanliness within six months of intervention.

- Encouragement of regular flossing and twice-daily brushing correlates with lower coronal caries incidence and reduced tooth loss over five-year follow-up in community-based elderly cohorts.

- Community outreach and screening programmes (e.g., the ElderSmile initiative) improve early detection and referral for definitive dental treatment among underserved older adults.

- Integration of oral health screening into routine geriatric and primary care assessments, alongside tele-dentistry and mobile dental units, can help overcome mobility- and transport-related barriers to access.
- Prosthetic rehabilitation, where clinically appropriate, should be paired with dietary counselling, since prosthesis provision alone does not reliably normalise nutritional intake.

Systematic reviews of these interventions report that the majority (64 of 81 studies in one scoping review) demonstrate statistically significant benefit, though heterogeneity in intervention type and outcome measurement limits the ability to draw firm comparative conclusions [3]. Policy-level actions—public health campaigns, mandatory or subsidised dental insurance, and dedicated geriatric oral health curricula for dental trainees—are repeatedly recommended as necessary complements to individual-level interventions [3,7].

9. CONCLUSION

Oral health-related quality of life in the elderly is shaped by an interacting web of clinical, systemic, cognitive, psychosocial, and structural determinants that extend well beyond simple counts of decayed, missing, or filled teeth. Xerostomia, prosthodontic status, subjective memory impairment, living arrangement, and socioeconomic disadvantage emerge across multiple independent cohorts as robust predictors of OHRQoL, while institutional and home-bound care settings consistently show the poorest outcomes [1,2,5,8]. Given the bidirectional relationship between oral health, nutrition, frailty, and systemic disease, a multidisciplinary approach—linking dentistry with geriatric medicine, nutrition, and social care—is essential. Prioritising preventive oral health education, equitable access to dental insurance and services, and targeted screening within existing geriatric care pathways represents the most actionable route to improving the quality of life of the growing elderly population worldwide [3,4,7].

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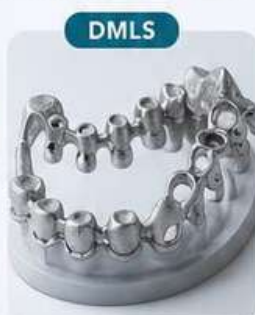
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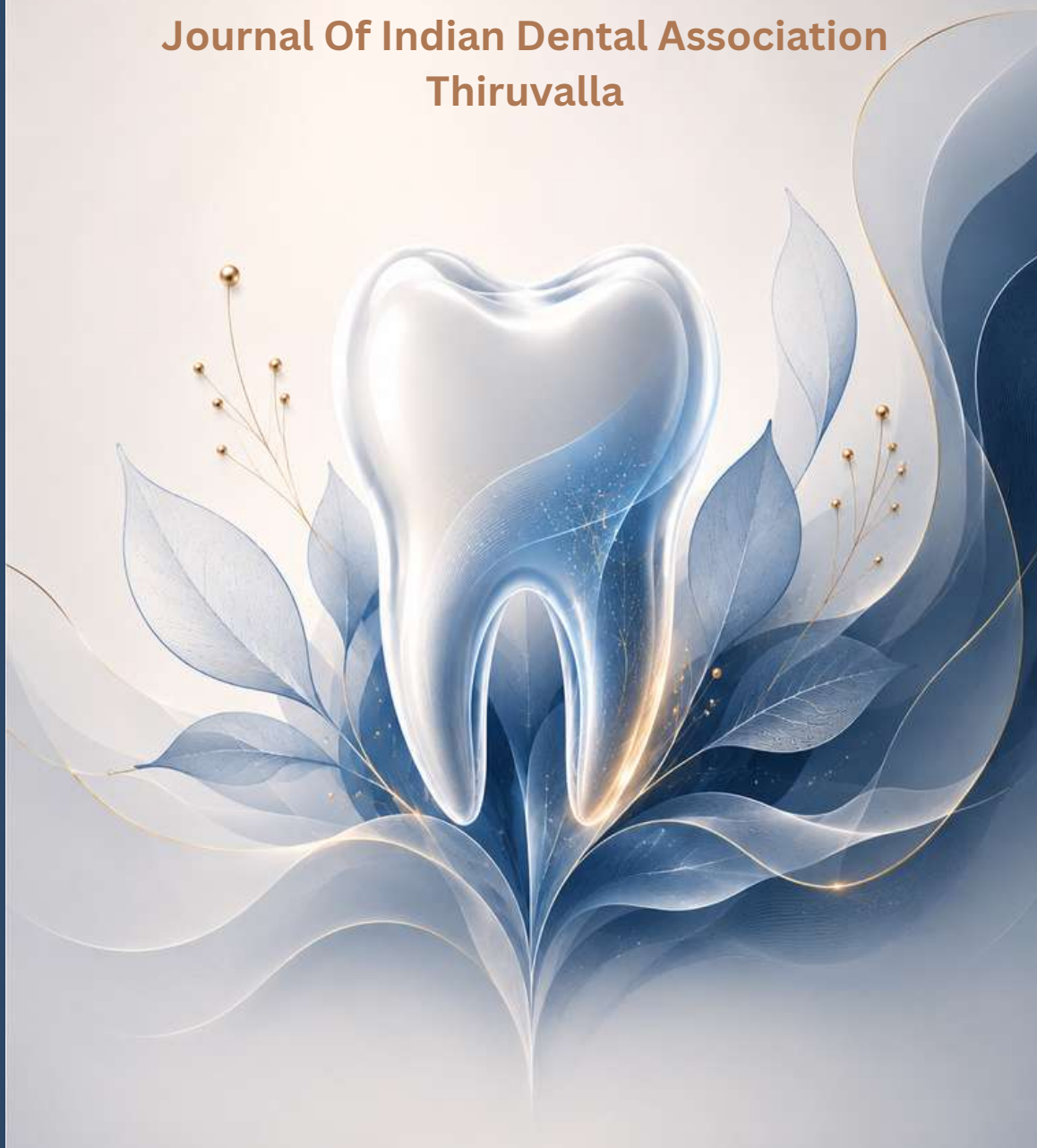


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