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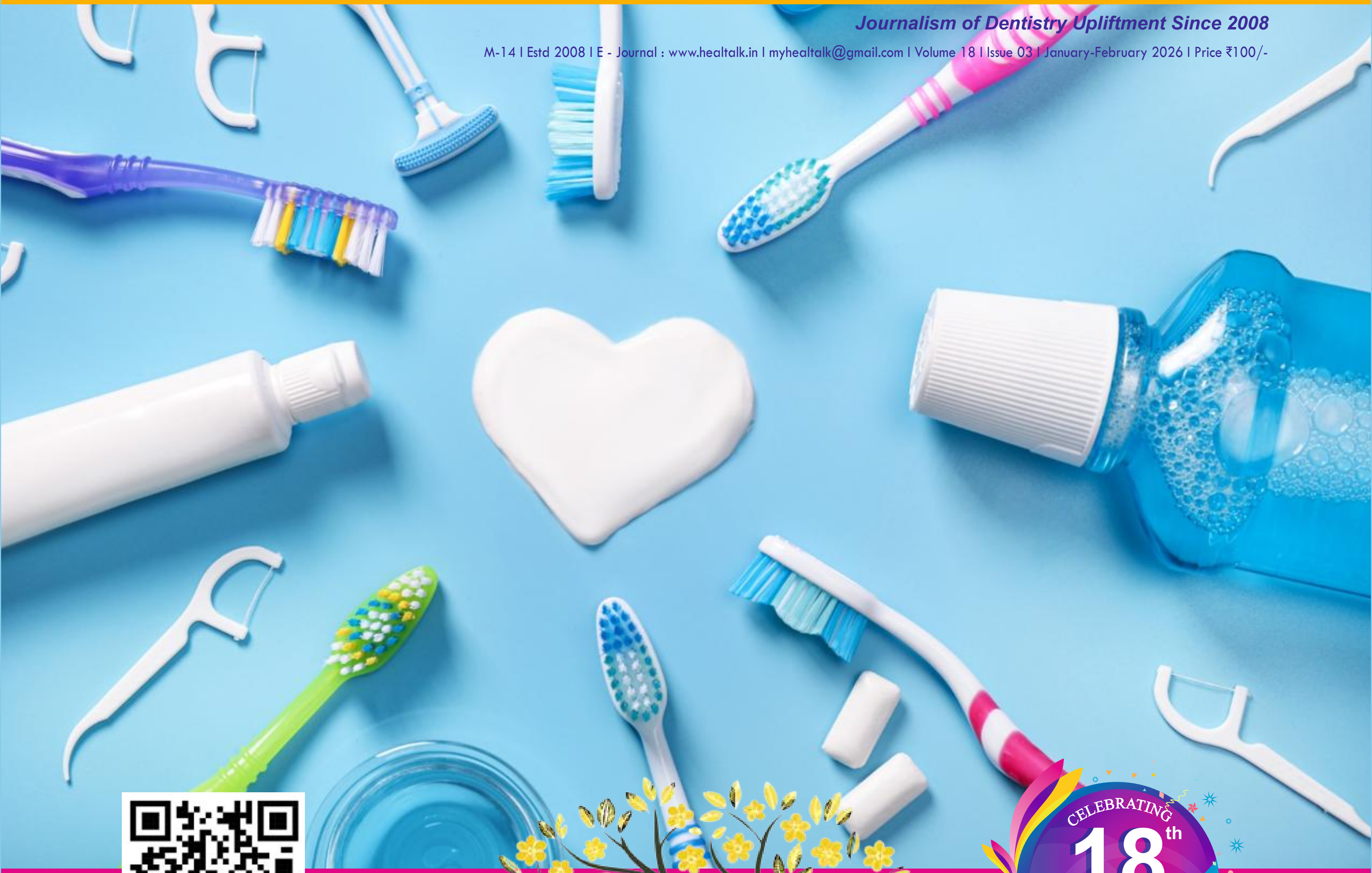

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Heal Talk

A Journal of Clinical Dentistry

Editorial

From The Desk of Guest Editor.....

The Great Reset: Unlearning Tradition to Embrace the Digital and AI Renaissance

As we navigate the rapidly evolving landscape of 21st-century dentistry, we find ourselves at a critical crossroads. For decades, the hallmark of a skilled prosthodontist was defined by the tactile mastery of elastomeric impressions and the artisanal precision of the lost-wax casting technique. However, the dawn of the Fourth Industrial Revolution has brought with it a "Great Reset." To move forward, we must now embrace a challenging but necessary process: unlearning.

For the modern practitioner, unlearning does not mean discarding the biological principles that govern our field. Instead, it means letting go of the manual, analog workflows that were once the "gold standard" but are now becoming bottlenecks in a world that demands higher precision, speed, and predictability.

From Physical Molds to Digital Pixels

The era of bulky impression trays, patient discomfort, and the inevitable dimensional instability of gypsum models is rapidly becoming a thing of the past. The traditional workflow fraught with human error and laboratory variables is being replaced by the seamless efficiency of Intraoral Scanning (IOS).

Today, CAD/CAM (Computer Aided Design and Computer Aided Manufacturing) is no longer a futuristic luxury; it is an accessible reality. With the cost of chairside scanners and milling units reaching a "graspable" price point, the barrier to entry has crumbled. We are moving from a "subtractive" past of casting and carving to an "additive" future where 3D Printing allows us to fabricate surgical guides, temporary crowns, and even final prostheses with a level of micron-level accuracy that manual casting could never consistently achieve.

The Intelligence Augmentation: AI in Prosthodontics

Perhaps the most profound shift is the integration of Artificial Intelligence (AI). We are seeing AI algorithms that can now automate margin detection, suggest ideal tooth morphology based on a patient's unique facial proportions, and even predict the long-term success of implant supported restorations. AI is not here to replace the clinician; it is here to augment our intelligence, reducing the "cognitive load" and allowing us to focus on the more complex, human elements of patient care.

Bridging the Gap: Integrating Tech into the Curriculum

The most significant challenge we face at institutions like Jamia Millia Islamia is not just the procurement of hardware, but the evolution of the dental curriculum. We must bridge the gap between "pre-clinical traditionalism" and "clinical modernization."

- Simulation Based Learning: Moving beyond the typodont to haptic VR simulators that allow students to practice digital preparations.
- Data Literacy: Teaching our students not just how to prep a tooth, but how to interpret 3D volumetric data and manage digital files.
- Evidence Based Tech: Ensuring that as we adopt new tools, we maintain a rigorous, evidence based approach to validate their clinical efficacy.

A Call to Action

To my fellow colleagues and the budding dental professionals: the transition may seem daunting. Shifting from the familiar "feel" of stone and wax to the "click" of a mouse requires a paradigm shift in our professional identity. Yet, the benefits reduced chairside time, superior patient comfort, and unparalleled clinical outcomes are too significant to ignore.

As we contribute to *Heal Talk*, let this be our collective mission: to remain students of our craft, to be brave enough to retire obsolete techniques, and to lead the charge into the digital and AI-driven future. The future of dentistry is not just in our hands; it is in our ability to adapt.

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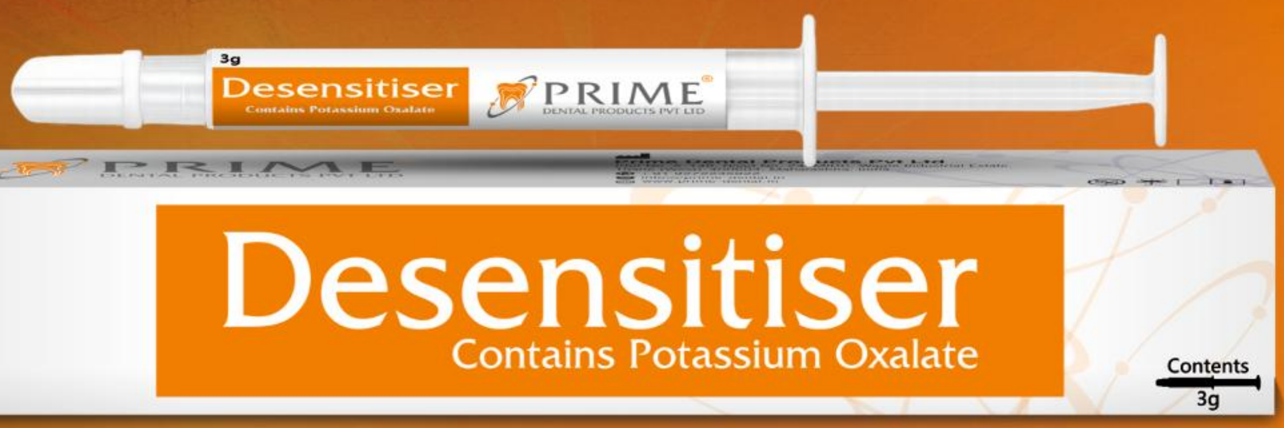

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Mesenchymal Tumors of the Oral Cavity: A Comprehensive Review

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Abstract

Background: Mesenchymal tumors of the oral cavity comprise a heterogeneous group of neoplasms arising from connective tissue, muscle, adipose tissue, blood vessels, peripheral nerves, cartilage, and bone. Although less common than epithelial tumors, their diverse histogenesis and overlapping clinical features pose significant diagnostic and therapeutic challenges.

Objective: To review the classification, clinical presentation, histopathological characteristics, diagnostic approaches, and management of mesenchymal tumors occurring in the oral cavity.

Materials and Methods: A comprehensive literature review was conducted using standard textbooks of oral pathology and published articles indexed in major scientific databases. Mesenchymal tumors were categorized according to the World Health Organization (WHO) classification, with emphasis on recent updates. Benign and malignant entities were reviewed with respect to their clinical features, radiographic findings, histopathology, differential diagnosis, and treatment modalities.

Results: Mesenchymal tumors of the oral cavity encompass a wide spectrum ranging from common benign lesions such as fibromas, lipomas, hemangiomas, and neurogenic tumors to rare but aggressive malignant neoplasms including fibrosarcoma, liposarcoma, rhabdomyosarcoma, and osteosarcoma. Accurate diagnosis relies on a combination of clinical examination, imaging, histopathology, immunohistochemistry, and molecular studies. Early recognition and appropriate classification are essential for optimal treatment planning and prognosis.

Conclusion: Mesenchymal tumors of the oral cavity represent a diagnostically complex group of lesions requiring a multidisciplinary approach. Advances in histopathological techniques and molecular diagnostics have significantly improved classification and management. A thorough understanding of these tumors is essential for oral physicians and pathologists to ensure accurate diagnosis and effective patient care.

Keywords: Mesenchymal tumors; Oral cavity; Soft tissue tumors; WHO classification; Oral pathology

Introduction

Mesenchymal tumors of the oral cavity constitute a diverse group of neoplasms derived from mesenchymal tissues including fibrous connective tissue, adipose tissue, muscle, blood vessels, lymphatics, peripheral nerves, cartilage, and bone. Although relatively uncommon compared to epithelial neoplasms, their clinical importance lies in their wide histological diversity, variable biological behavior, and potential for diagnostic ambiguity.

The oral and maxillofacial region is embryologically complex, with mesenchymal tissues originating from both mesoderm and neural crest cells. This dual origin accounts for the broad spectrum of mesenchymal tumors encountered in this region. These tumors may present as innocuous, slow growing benign lesions or as aggressive malignant neoplasms capable of extensive local destruction and distant metastasis.

Historically, classification of mesenchymal tumors was based primarily on histomorphology. However, advances in immunohistochemistry, cytogenetics, and molecular pathology have significantly refined diagnostic accuracy. The World Health Organization (WHO) classification of soft tissue and bone tumors now integrates histological features with molecular and genetic characteristics, providing a standardized framework for diagnosis and management.

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Clinically, mesenchymal tumors often present as painless swelli-ngs or nodular masses and may mimic reactive or inflammatory lesions. Malignant counterparts frequently demonstrate rapid growth, pain, ulceration, and functional impairment. Early re-cognition and precise diagnosis are therefore essential for optimal treatment planning and prognosis

Classification of Mesenchymal Tumors of the Oral Cavity

According to the WHO classification, mesenchymal tumors are broadly categorized based on tissue differentiation:

- Adipocytic Tumors
- Fibroblastic and Myofibroblastic Tumors
- Fibrohistiocytic Tumors
- Smooth Muscle Tumors
- Skeletal Muscle Tumors
- Vascular and Lymphatic Tumors
- Chondro-osseous Tumors
- Peripheral Nerve Sheath Tumors
- Tumors of Uncertain Differentiation
- Undifferentiated/Unclassified Sarcomas

Each category includes benign, intermediate, and malignant entities, emphasizing biological behavior and clinical relevance.

Category	Benign Tumors	Malignant Tumors
Adipocytic	Lipoma, Lipoblastoma	Liposarcoma
Fibroblastic / Myofibroblastic	Fibroma, Fibromatosis, Myofibroma	Fibrosarcoma
Fibrohistiocytic	Benign fibrous histiocytoma	Undifferentiated pleomorphic sarcoma
Smooth muscle	Leiomyoma	Leiomyosarcoma
Skeletal muscle	Rhabdomyoma	Rhabdomyosarcoma
Vascular / Lymphatic	Hemangioma, Lymphangioma	Angiosarcoma, Kaposi sarcoma
Chondro-osseous	Osteoma, Chondroma	Osteosarcoma, Chondrosarcoma
Peripheral nerve sheath	Neurofibroma, Schwannoma	MPNST
Tumors of uncertain differentiation	Myxoma	Synovial sarcoma

Table 1. WHO classification of mesenchymal tumors affecting the oral cavity

Benign Mesenchymal Tumors of the Oral Cavity

Benign mesenchymal tumors constitute the majority of oral mesenchymal lesions. Common examples include fibroma, lipoma, hemangioma, lymphangioma, neurofibroma, schwannoma, leio-myoma, and myxoma.

These tumors typically present as slow growing, painless masses with well circumscribed borders. Fibromas are among the most frequently encountered lesions and are often reactive in nature. Lipomas appear as soft, yellowish nodules, commonly involving the buccal mucosa and tongue. Vascular tumors such as hemangiomas and lymphangiomas may cause functional problems due to bleeding or airway compromise. Neural tumors are usually asymptomatic but may be associated with syndromic conditions.

Histopathological examination confirms the diagnosis, with immunohistochemical markers assisting in identifying tissue line-age. Surgical excision remains the treatment of choice, and recur-rence is generally uncommon.

Figure 1. Clinical appearance of oral fibroma presenting as a well-circum-scribed, firm, painless nodular mass on the buccal mucosa.

Malignant Mesenchymal Tumors of the Oral Cavity

Malignant mesenchymal tumors, collectively referred to as sarcomas, are rare but aggressive. These include fibrosarcoma, liposarcoma, leiomyosarcoma, rhabdomyosarcoma, angiosar-coma, osteosarcoma, and malignant peripheral nerve sheath tumors.

Clinically, these tumors often present with rapid enlargement, pain, ulceration, and invasion of adjacent structures. Radiographic imaging may reveal bone destruction or soft tissue infiltration. Histologically, malignant tumors exhibit cellular atypia, increased mitotic activity, necrosis, and infiltrative growth patterns.

Management typically involves wide surgical excision, often combined with radiotherapy and chemotherapy depending on tumor type and stage. Prognosis varies based on tumor grade, size, location, and presence of metastasis.

Diagnostic Approach

Accurate diagnosis of mesenchymal tumors requires a multi-disciplinary approach. Clinical examination provides initial infor-mation regarding lesion size, consistency, and mobility. Imaging modalities such as radiographs, computed tomography (CT), and magnetic resonance imaging (MRI) are essential for assessing tumor extent and bone involvement.

Histopathological examination remains the gold standard for diagnosis. Immunohistochemistry aids in differentiating histo-logically similar lesions using markers such as S-100, desmin, smooth muscle actin, vimentin, and CD34. Molecular diagnostic techniques, including fluorescence in situ hybridization (FISH) and polymerase chain reaction (PCR), further enhance diagnostic precision.

Marker	Tumor Association
Vimentin	Mesenchymal origin
S-100	Neural tumors
Desmin	Muscle tumors
SMA	Smooth muscle, myofibroblastic
CD34	Vascular tumors
Myogenin	Rhabdomyosarcoma

Table: Common immunohistochemical markers in mesenchymal tumors

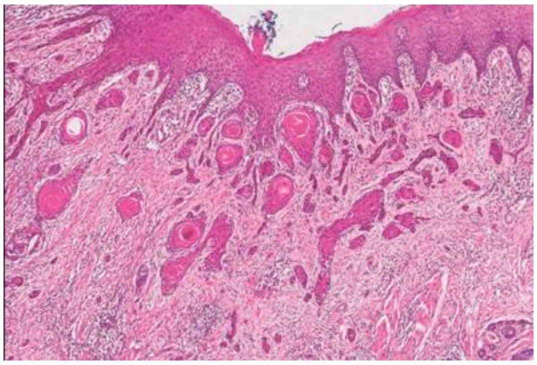

Figure 2. Histopathological features of mesenchymal tumors showing spindle shaped cells on hematoxylin and eosin staining.

Management and Prognosis

Management strategies depend on tumor type, biological behavior, and anatomical location. Benign tumors are generally managed with conservative surgical excision and have an excellent prognosis. Malignant tumors require aggressive treatment with a combination of surgery, radiotherapy, and chemotherapy.

Long-term follow-up is essential due to the risk of recurrence and metastasis, particularly in high grade sarcomas. Early diagnosis significantly improves treatment outcomes and survival rates.

Future Perspectives

Advances in molecular pathology and targeted therapies hold promise for improving the diagnosis and management of mesenchymal tumors. Identification of specific genetic alterations may enable personalized treatment strategies and improved prognostication.

Conclusion

Mesenchymal tumors of the oral cavity represent a complex and heterogeneous group of neoplasms with diverse clinical and biological behavior. Accurate diagnosis relies on a combination of clinical, radiological, histopathological, and molecular findings. A thorough understanding of these tumors is essential for clinicians and pathologists to ensure optimal patient management and outcomes.

References

1. Fletcher CDM, Bridge JA, Hogendoorn PCW, Mertens F. WHO Classification of Tumours of Soft Tissue and Bone. 5th ed. Lyon: IARC Press; 2020.
2. Neville BW, Damm DD, Allen CM, Chi AC. Oral and Maxillofacial Pathology. 4th ed. St. Louis: Elsevier; 2016.
3. Barnes L, Eveson JW, Reichart P, Sidransky D. World Health Organization Classification of Tumours: Pathology and Genetics of Head and Neck Tumours. Lyon: IARC Press; 2005.
4. Enzinger FM, Weiss SW. Soft Tissue Tumors. 6th ed. St. Louis: Mosby; 2014.
5. Regezi JA, Sciubba JJ, Jordan RCK. Oral Pathology: Clinical Pathologic Correlations. 7th ed. St. Louis: Elsevier; 2017.
6. Slootweg PJ. Lesions of the jaws. Histopathology. 2009; 54 (4): 401–418.
7. Ide F, Mishima K, Saito I. Mesenchymal tumors of the oral cavity: an update. J Oral Pathol Med. 2008; 37 (8): 449–459.
8. Pontes FSC, Pontes HAR, de Sousa FACG, et al. Oral soft tissue tumors: a clinicopathologic study of 200 cases. Med Oral Patol Oral Cir Bucal. 2012;17 (3): e408–e412.
9. Van der Waal I. Soft tissue tumors of the oral cavity. J Oral Pathol Med. 1995; 24 (9): 421–426.
10. Ethunandan M, Mellor TK. Hemangiomas and vascular malformations of the maxillofacial region: a review. Br J Oral Maxillofac Surg. 2006; 44 (4): 263–272.
11. Miettinen M. Immunohistochemistry of soft tissue tumors review with emphasis on differential diagnosis. Arch Pathol Lab Med. 2014;138 (6): 789–803.
12. Folpe AL, Inwards CY. Bone and Soft Tissue Pathology. Philadelphia: Saunders; 2010.
13. Fisher C. Immunohistochemistry in diagnosis of soft tissue tumours. Histopathology. 2011; 58 (7): 1001–1012.
14. Kransdorf MJ. Malignant soft-tissue tumors in a large referral population: distribution of diagnoses by age, sex, and location. AJR Am J Roentgenol. 1995;164 (1):129–134.
15. Weiss SW, Goldblum JR. Enzinger and Weiss's Soft Tissue Tumors. 6th ed. Philadelphia: Mosby Elsevier; 2014.

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Body Fluids in Forensic Science: Biochemical Insights

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Abstract

Background: Body fluids recovered from crime scenes represent a cornerstone of forensic investigations. Beyond their DNA content, the biochemical and molecular composition of these fluids provides crucial information for identification, reconstruction, and interpretation of forensic evidence.

Objective: To review the biochemical characteristics of major body fluids and their applications in forensic science, with emphasis on conventional serology and emerging molecular techniques.

Materials and Methods: A narrative literature review was performed using standard forensic textbooks, peer reviewed journals, and authoritative forensic databases. Classical presumptive and confirmatory tests were analyzed alongside advanced methods such as mRNA profiling, proteomics, and spectroscopic techniques.

Results: Blood, saliva, sweat, and urine exhibit unique biochemical signatures that enable forensic differentiation. Traditional chemical and immunological tests remain useful but are limited by sample destruction and cross reactivity. Emerging molecular and spectroscopic approaches demonstrate superior sensitivity, specificity, and non-destructive capabilities.

Conclusion: Integration of biochemical, molecular, and spectroscopic methods has significantly enhanced body fluid identification in forensic science. Continued research and validation are essential for routine forensic implementation.

Keywords: Forensic science, body fluids, serology, biochemical analysis, DNA profiling

Introduction

Biological evidence plays a pivotal role in forensic investigations by linking suspects, victims, and crime scenes. Among such evidence, body fluids are of particular importance due to their rich biochemical and genetic content. Identification of body fluids not only confirms the presence of biological material but also provides contextual information critical for reconstruction of criminal events. Traditional forensic serology relied on presumptive and confirmatory chemical tests. However, these methods often require destructive sampling and may yield false positive results. Recent advances in forensic biochemistry and molecular biology have introduced novel approaches capable of accurate, non-destructive body fluid identification.

Figure 1. Bloodstain patterns at a crime scene (clinical forensic appearance)

Historical Overview

The origins of forensic body fluid analysis date back to ancient civilizations. Early Chinese texts described crude blood detection methods, while medieval European practices employed empirical stain differentiation. Scientific rigor emerged in the nineteenth century with the work of Orfila and later Landsteiner's discovery of blood groups, which revolutionized forensic serology.

The establishment of forensic laboratories in the early twentieth century marked a turning point, leading to standardized biochemical and immunological testing. The advent of DNA profiling in the late twentieth century further transformed forensic science, enabling individualization of biological evidence.

Classification of Body Fluids in Forensic Science

Forensic body fluids commonly encountered at crime scenes include:

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- Blood
- Saliva
- Semen
- Vaginal Secretions
- Sweat
- Urine

Each fluid possesses distinct biochemical and molecular markers that facilitate forensic identification.

Biochemical Characteristics of Major Body Fluids

Blood

Blood is composed of plasma and cellular elements, including erythrocytes, leukocytes, and platelets. Hemoglobin, plasma proteins, and cellular morphology form the basis of traditional blood identification. Molecular techniques such as microRNA profiling and DNA methylation analysis now allow precise differentiation even in degraded samples

Saliva

Saliva consists primarily of water, electrolytes, enzymes, and immunoglobulins. α-Amylase remains a key marker in presumptive testing, while RNA and microbial profiling provide confirmatory identification. Saliva is particularly relevant in cases involving bite marks and sexual offenses.

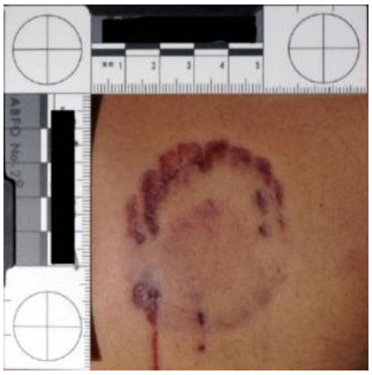

Figure 2. Saliva evidence in forensic examination (clinical context)

Sweat

Sweat is secreted mainly by eccrine glands and contains electrolytes, metabolites, and antimicrobial peptides. Although traditionally underutilized, recent advances in metabolomics and microbiome analysis have highlighted its forensic potential.

Urine

Urine is an aqueous metabolic waste product containing urea, creatinine, and electrolytes. Its forensic relevance lies in toxicological analysis and, increasingly, epigenetic profiling for body fluid differentiation.

Figure 3. Urine and sweat as forensic biological evidence (Clinical Samples)

Body fluid	Principal biochemical components	Key forensic markers	Forensic relevance
Blood	Plasma proteins (albumin, fibrinogen), hemoglobin, RBCs, WBCs, platelets	Hemoglobin, heme, miRNA (miR-451, miR-16)	Most common forensic fluid; enables DNA profiling, bloodstain pattern analysis, and source attribution
Saliva	Water (≈99%), α-amylase, mucins, IgA, electrolytes	α-Amylase, statherin, miRNA (miR-658)	Important in bite marks, sexual assault cases, and trace DNA recovery
Sweat	Water, Na^+,Cl^-,K^+,urea, lactate, antimicrobial peptides	Dermcidin, cytokines, metabolomic signatures	Useful in contact traces and emerging metabolomic and microbiome studies
Urine	Urea, creatinine, electrolytes, metabolites	Urea, creatinine, DNA methylation markers	Relevant in toxicology, drug detection, and metabolic profiling
Semen	Spermatozoa, seminal plasma proteins, fructose	PSA (p30), semenogelin, miRNA (miR-135b)	Critical evidence in sexual offence investigations

Table 1. Major body fluids encountered in forensic investigations and their biochemical characteristics

Discussion

Conventional presumptive tests such as Kastle-Meyer and Phadebas remain widely used due to their simplicity and cost-effectiveness. However, their limitations underscore the need for advanced confirmatory techniques. Molecular approaches, including mRNA, microRNA, and proteomic profiling, offer high specificity and sensitivity with minimal sample consumption. Spectroscopic techniques such as Raman and surface enhanced Raman spectroscopy provide rapid, non-destructive identification, preserving DNA for downstream analysis.

Method type	Technique	Target analyte	Advantages	Limitations
Presumptive tests	Kastle–Meyer, phenolphthalein	Hemoglobin	Rapid, cost-effective	False positives, sample destruction
Confirmatory tests	Phadebas test	Amylase	Simple saliva screening	Low specificity
	ABAcard® Hematrace	Human hemoglobin	Species-specific	Requires sample consumption
	Takayama / Teichmann tests	Heme crystals	Confirmatory for blood	Destructive, limited sensitivity
Molecular methods	mRNA profiling	Tissue-specific transcripts	High specificity, fluid differentiation	RNA degradation risk
	microRNA analysis	Stable miRNA markers	Works on degraded samples	Requires validation
Proteomic methods	LC-MS / MALDI TOF	Fluid-specific proteins	High accuracy, multiplexing	Instrument - dependent
Spectroscopic methods	Raman / SERS spectroscopy	Molecular fingerprints	Non-destructive, rapid	Requires spectral databases

Table 2. Conventional and advanced methods used for forensic body fluid identification.

Figure 4. Presumptive blood testing on suspected stains (clinical setup)

Future Perspectives

The future of forensic body fluid identification lies in integrating biochemical, molecular, and spectroscopic technologies. Portable, non-destructive devices capable of real time analysis at crime scenes are anticipated. Standardization, validation, and legal acceptance of emerging techniques remain critical challenges.

Conclusion

Body fluid analysis remains a cornerstone of forensic science. Advances in biochemical and molecular methodologies have significantly enhanced the accuracy and reliability of body fluid identification. Continued interdisciplinary research will further strengthen forensic investigations and judicial outcomes.

References

1. Virkler K, Lednev IK. Analysis of body fluids for forensic purposes: From laboratory testing to non-destructive rapid confirmatory identification at a crime scene. Forensic Sci Int. 2009;188 (1-3):1-17.
2. Butler JM. Advanced Topics in Forensic DNA Typing: Methodology. San Diego: Academic Press; 2012.
3. Juusola J, Ballantyne J. Messenger RNA profiling: A prototype method to supplant conventional methods for body fluid identification. Forensic Sci Int. 2003;135 (2): 85-96.
4. Haas C, Hanson E, Anjos MJ, Ballantyne J. RNA/DNA co-analysis from human saliva and semen stains: A proof of concept study. Forensic Sci Int Genet. 2011;5(4):336-344.
5. Van Steendam K, Deforce D, Dhaenens M, Van Nieuwerburgh F. Mass spectrometry based proteomics as a tool to identify biological matrices in forensic science. Int J Legal Med. 2013; 127 (2): 287-298.
6. Yang H, Zhou B, Deng L, et al. Proteomic analysis for forensic identification of body fluids using MALDI-TOF/TOF mass spectrometry. Forensic Sci Int. 2013; 230 (1-3): 52-58.
7. McLaughlin G, Lednev IK. Raman spectroscopy of blood and bloodstains for forensic purposes. Anal Bioanal Chem. 2015; 407 (3): 821-831.
8. Sikirzhytski V, Sikirzhytskaya A, Lednev IK. Multivariate analysis of Raman spectra for quantitative identification of body fluid traces. Anal Chem. 2012;84(18):7898-7904.
9. Tobe SS, Watson N, Daeid NN. Evaluation of six presumptive tests for blood, their specificity, sensitivity, and effect on high molecular weight DNA. J Forensic Sci. 2007; 52 (1): 102-109.
10. Hedman J, Dalin E, Rasmusson B, Ansell R. Evaluation of amylase based presumptive tests for saliva. Forensic Sci Int. 2008; 173 (2-3): 102-109.
11. Landsteiner K. Über Agglutinationserscheinungen normalen menschlichen Blutes. Wien Klin Wochenschr. 1901;14:1132-1134.
12. Jeffreys AJ, Wilson V, Thein SL. Individual specific fingerprints of human DNA. Nature. 1985; 316 (6023): 76-79.
13. Bremmer RH, de Bruin KG, van Gemert MJ, et al. Forensic quest for age determination of bloodstains. Forensic Sci Int. 2012; 216 (1-3): 1-11.
14. Hanson EK, Ballantyne J. Rapid and inexpensive body fluid identification by RNA profiling based multiplex. Forensic Sci Int Genet. 2013; 7 (1): 1-9.
15. Lednev IK, Sikirzhytski V, Virkler K. Raman spectroscopy in forensic science: A review. Forensic Sci Rev. 2012; 24 (1): 1-32.

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Abstract

Hormones play a pivotal role in maintaining oral tissue homeostasis by regulating cellular metabolism, immune responses, vascular integrity, and bone remodeling. Alterations in hormonal balance whether physiological, such as puberty, pregnancy, and menopause, or pathological, such as endocrine gland disorders can significantly influence oral health. The oral cavity frequently reflects early manifestations of systemic hormonal disturbances, presenting as gingival inflammation, altered salivary flow, periodontal destruction, mucosal lesions, and changes in bone density. This narrative review synthesizes current evidence on the effects of hormonal imbalances on oral tissues, emphasizing pituitary, thyroid, parathyroid, adrenal, pancreatic, and gonadal hormone disorders, as well as stress-related hormonal dysregulation. Understanding these interactions is essential for early diagnosis, interdisciplinary management, and improved oral and systemic health outcomes.

Keywords: Hormonal imbalance, oral tissues, endocrine disorders, periodontal disease, xerostomia, alveolar bone loss.

Introduction

Hormones act as chemical messengers that regulate numerous physiological processes essential for maintaining systemic and oral homeostasis. The oral cavity, comprising soft tissues, salivary glands, teeth, and alveolar bone, is highly sensitive to fluctuations in hormonal levels. Variations in estrogen, progesterone, testosterone, thyroid hormones, cortisol, insulin, and growth hormone can disrupt normal tissue responses, leading to diverse oral manifestations.

Physiological hormonal changes during puberty, pregnancy, and menopause are often associated with exaggerated inflammatory responses to plaque, increased gingival vascularity, xerostomia, and altered taste perception. Similarly, endocrine disorders such as diabetes mellitus, thyroid dysfunction, polycystic ovary syndrome (PCOS), and adrenal disorders contribute to periodontal destruction, delayed wound healing, and mucosal pathology. Consequently, the oral cavity serves as a critical indicator of underlying hormonal imbalance, underscoring the dentist's role in early detection and interdisciplinary care.

Figure 1. Xerostomia associated with hormonal imbalance

Hormonal Regulation of Oral Tissues

Hormones influence oral tissues through receptor mediated mechanisms affecting epithelial turnover, connective tissue metabolism, immune modulation, and bone remodeling. Estrogen and progesterone modulate gingival vascularity and inflammatory responses, while thyroid hormones regulate craniofacial growth and tooth eruption. Parathyroid hormone maintains

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calcium phosphate balance essential for alveolar bone integrity, and insulin plays a key role in periodontal wound healing. Cortisol, particularly during chronic stress, suppresses immune responses and delays tissue repair, predisposing to oral infections and mucosal lesions.

Endocrine Gland	Hormonal Imbalance	Systemic Condition	Key Oral Manifestations
Pituitary	Growth Hormone	Acromegaly	Mandibular prognathism, macroglossia, interdental spacing, thick gingival biotype, bony exostoses
Pituitary	Growth Hormone	Pituitary dwarfism	Delayed tooth eruption, retained deciduous teeth, micrognathia, enamel hypoplasia
Thyroid	T3/T4	Hyperthyroidism	Early tooth eruption, gingival bleeding, periodontal disease, alveolar bone loss
Thyroid	T3/T4	Hypothyroidism	Macroglossia, delayed eruption, enamel hypoplasia, xerostomia
Parathyroid	PTH	Hyperparathyroidism	Loss of lamina dura, brown tumors, tooth mobility
Parathyroid	PTH	Hypoparathyroidism	Enamel hypoplasia, delayed eruption, oral candidiasis
Adrenal	Cortisol	Cushing's syndrome	Delayed wound healing, oral candidiasis, osteopenia
Adrenal	Cortisol	Addison's disease	Diffuse oral mucosal pigmentation
Pancreas	Insulin	Diabetes mellitus	Severe periodontitis, xerostomia, burning mouth syndrome
Gonads	Estrogen	Menopause	Xerostomia, burning mouth syndrome, alveolar bone loss
HPA Axis	Cortisol	Chronic stress	Oral lichen planus, aphthous ulcers, bruxism

Table 1. Classification of endocrine disorders and their oral manifestations

Pituitary Gland Disorders

Growth hormone (GH) imbalance pro -foundly affects craniofacial development and oral structures.

Acromegaly

Excess GH secretion in adulthood leads to mandibular prognathism, macroglossia, interdental spacing, thick gingival biotype, and bony outgrowths such as mandibular tori. Radiographically, enlarged mandibular dimensions and cortical bone thickening are common. These oral features may precede systemic diagnosis, highlighting the diagnostic importance of dental evaluation.

Pituitary Dwarfism

GH deficiency during childhood results in delayed tooth eruption, retained deciduous dentition, micrognathia, narrow dental arches, and enamel hypoplasia. Radiographs typically show delayed dental age and underdeveloped roots, reflecting impaired skeletal maturation.

Figure 2. Oral manifestations of acromegaly

Thyroid Gland Disorders

Thyroid hormones are essential for normal metabolic activity and skeletal development.

Hyperthyroidism

Accelerated metabolism in hyperthyroidism is associated with early tooth eruption, increased susceptibility to periodontal disease, gingival bleeding, and alveolar bone loss. Reduced salivary flow may further increase caries risk.

Hypothyroidism

Hypothyroidism leads to macroglossia, thickened lips, delayed eruption of teeth, enamel hypoplasia, xerostomia, and increased caries prevalence. Radiographic findings often include delayed dental age, widened pulp chambers, and poorly mineralized bone.

Parathyroid Gland Disorders

Parathyroid hormone (PTH) regulates calcium homeostasis and bone remodeling.

Hyperparathyroidism

Excess PTH causes generalized bone resorption, loss of lamina dura, ground-glass appearance of jaws, and brown tumors. Clinically, patients may present with tooth mobility and jaw swelling mimicking periodontal or neoplastic lesions.

Hypoparathyroidism

PTH deficiency results in enamel hypoplasia, delayed eruption, shortened roots, and increased susceptibility to oral candidiasis. Neuromuscular irritability may coexist with dental developmental defects.

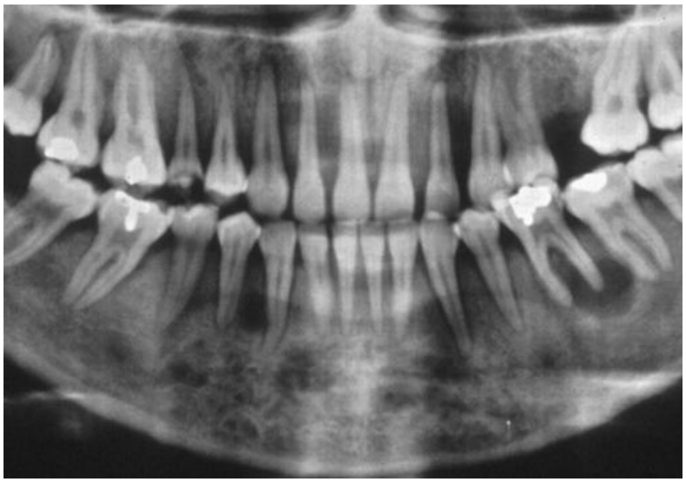

Figure 3. Brown tumor of the jaw in hyperparathyroidism

Adrenal Gland Disorders

Cortisol imbalance significantly impacts oral tissues.

Cushing's Syndrome

Prolonged hypercortisolism leads to osteopenia of alveolar bone, delayed wound healing, mucosal thinning, and increased susceptibility to oral infections.

Addison's Disease

Adrenal insufficiency is characterized by diffuse oral mucosal pigmentation due to increased adrenocorticotropic hormone (ACTH) activity, often serving as an early diagnostic clue.

Pancreatic Hormone Disorders (Diabetes Mellitus)

Diabetes mellitus is strongly associated with periodontal disease severity. Chronic hyperglycemia impairs immune function and collagen metabolism, resulting in severe periodontitis, xerostomia, burning mouth syndrome, delayed healing, and recurrent candidiasis. Radiographic findings often reveal advanced alveolar bone loss.

Figure 4. Periodontal destruction in diabetes mellitus

Gonadal Hormone Imbalances

Estrogen and progesterone fluctuations during puberty, pregnancy, and menopause significantly influence gingival inflammation and bone density. Pregnancy gingivitis and pyogenic granulomas are common during gestation, while menopause is associated with xerostomia, burning mouth syndrome, and alveolar bone loss. Testosterone deficiency in males has been linked to emerging periodontal risk.

Oral Tissue	Primary Hormones Involved	Effect of Hormonal Imbalance	Clinical Presentation
Gingiva	Estrogen, Progesterone	Increased vascularity and inflammation	Gingivitis, bleeding on probing
Periodontium	Insulin, Cortisol	Impaired immune response and healing	Periodontitis, attachment loss
Salivary glands	Estrogen, Androgens	Reduced salivary flow	Xerostomia, increased caries risk
Alveolar bone	Estrogen, PTH, Thyroid hormones	Altered bone remodeling	Osteopenia, tooth mobility
Oral mucosa	Cortisol, Estrogen	Mucosal thinning and immune suppression	Burning mouth syndrome, ulcers
Teeth	Thyroid hormones, Growth hormone	Altered odontogenesis and eruption	Delayed or premature tooth eruption, enamel defects

Table 2. Hormonal regulation of oral tissues and associated clinical manifestations

Stress-Related Hormonal Dysregulation

Chronic stress activates the hypothalamic–pituitary–adrenal axis, increasing cortisol levels. This contributes to oral lichen planus, recurrent aphthous ulcers, xerostomia, bruxism, and delayed periodontal healing, demonstrating the complex interaction between psychological stress, hormones, and oral health.

Clinical Implications and Future Perspectives

Recognition of hormone-related oral manifestations enables early diagnosis of systemic endocrine disorders. Salivary diagnostics, molecular biomarkers, hormone replacement therapy, regenerative approaches, and interdisciplinary collaboration between dentists and endocrinologists are crucial for comprehensive patient care.

Conclusion

Hormonal imbalances exert profound effects on oral tissues, influencing inflammatory responses, salivary function, bone metabolism, and tissue repair. The oral cavity frequently mirrors systemic endocrine disturbances, positioning dental professionals at the forefront of early detection and multidisciplinary management. Enhanced awareness and integrated healthcare approaches can significantly improve both oral and systemic health outcomes.

References

1. Shafer WG, Hine MK, Levy BM. Shafer's Textbook of Oral Pathology. 9th ed. New Delhi: Elsevier; 2024.
2. Neville BW, Damm DD, Allen CM, Chi AC. Oral and Maxillofacial Pathology. 5th ed. St. Louis: Elsevier; 2023.
3. Kesidi S, Bhayya DP. Hormonal influences on periodontal tissues. J Indian Soc Periodontol. 2019;23(4):312–318.
4. Kadhom ZH, Radhi NJ. Oral manifestations in hypothyroid patients: A case–control study. J Oral Maxillofac Pathol. 2023;27(1):45–50.
5. Carlos JP. Endocrine disorders and oral manifestations. Dent Clin North Am. 2010;54(3):531–543.
6. Preshaw PM, Alba AL, Herrera D, et al. Periodontitis and diabetes: A two-way relationship. Diabetologia. 2012; 55(1):21–31.
7. Löe H. Periodontal changes in pregnancy. J Periodontol. 1965;36(3):209–217.
8. Amar S, Leeman S. Periodontal innate immune mechanisms relevant to hormone-related changes. Periodontol 2000. 2013;63(1):129–145.
9. Glick M. Burket's Oral Medicine. 13th ed. Hoboken: Wiley-Blackwell; 2021.
10. Mealey BL, Oates TW. Diabetes mellitus and periodontal diseases. J Periodontol. 2006;77(8):1289–1303.
11. Friedlander AH, Mahler ME. Major depressive disorder: Psychopathology, medical management and dental implications. J Am Dent Assoc. 2001;132(5):629–638.
12. Melmed S. Acromegaly pathogenesis and treatment. J Clin Endocrinol Metab. 2019;104(12):5373–5384.
13. Ferrante E, Giavoli C, Mantovani G, et al. Oral and craniofacial features in pituitary disorders. Endocr Rev. 2017; 38(4):405–430.
14. Silva MJ, Sousa LG, Corrêa JD, et al. Oral health status of patients with thyroid disorders. Clin Oral Investig. 2015; 19(6):1357–1363. Pinto A, Glick M. Management of patients with thyroid disease: Oral health considerations. J Am Dent Assoc. 2002;133(7):849–858.

Heal Talk

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Biomaterials in Periodontal Therapy: Current Concepts, Clinical Applications and Future Perspectives

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Abstract

Periodontitis is a chronic inflammatory disease characterized by progressive destruction of the tooth supporting structures, ultimately leading to tooth loss if left untreated. Conventional periodontal therapies aim to control infection and inflammation but have limited capacity to regenerate lost periodontal tissues. Over the past few decades, biomaterials have emerged as essential adjuncts in periodontal regeneration, enabling reconstruction of alveolar bone, periodontal ligament, and cementum. This review provides a comprehensive overview of biomaterials used in periodontal therapy, including their classification, sources, biological properties, and clinical applications. Emphasis is placed on bone graft substitutes, barrier membranes, scaffolds, hydrogels, and biologically active materials such as enamel matrix derivatives and platelet concentrates. Recent advances in tissue engineering, smart biomaterials, and immunomodulatory approaches are also discussed. Despite significant progress, complete and predictable periodontal regeneration remains challenging, highlighting the need for further translational research and clinically oriented innovations.

Keywords: Biomaterials, Periodontal regeneration, Bone grafts, Guided tissue regeneration, Scaffolds, Tissue engineering

Introduction

The periodontium comprises gingiva, periodontal ligament, cementum, and alveolar bone, all of which are essential for tooth support and function. Periodontitis is a multifactorial, non-communicable inflammatory disease driven by microbial biofilms and a dysregulated host immune response, resulting in progressive loss of periodontal tissues. While nonsurgical and surgical periodontal therapies are effective in controlling disease activity, they do not reliably restore the original architecture and function of the periodontium.

Regenerative periodontal therapy aims to re-establish lost tissues through biologically driven healing processes. Biomaterials have become integral to this goal by providing structural support, biological cues, and controlled delivery of bioactive molecules. Advances in material science and tissue engineering have significantly expanded the therapeutic armamentarium available to periodontists.

Historical Background of Biomaterials in Periodontology

The use of biomaterials in periodontal therapy has evolved steadily over the last century. Early use of calcium sulfate and calcium phosphate compounds laid the foundation for bone substitute materials. The introduction of hydroxyapatite, bioactive glasses, freeze dried bone allografts, and xenografts represented major milestones in periodontal regeneration. Subsequently, biologically active materials such as platelet rich fibrin and enamel matrix derivatives further advanced regenerative outcomes. These developments underscore the transition from passive grafting materials to biointeractive and regenerative biomaterials.

Definition and Concept of Biomaterials

According to the International Union of Societies for Biomaterials Science and Engineering, a biomaterial is defined as a material designed to interact with biological systems for therapeutic or diagnostic purposes. Regenerative biomaterials specifically aim to induce tissue regeneration by modulating cellular behavior and molecular signaling pathways without necessarily incorporating exogenous cells or growth factors. In periodontology, biomaterials serve as scaffolds, barriers, space maintainers, and delivery systems to promote periodontal tissue regeneration.

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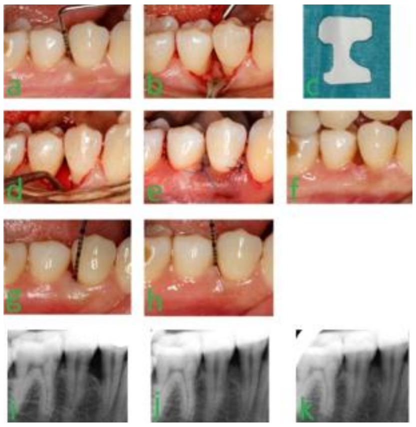

Figure1. Clinical photograph showing an intrabony periodontal defect after flap reflection.

Classification of Biomaterials

Based on Biocompatibility

- Bioactive materials: Promote direct bonding with bone and stimulate osteogenesis
- Biotolerant materials: Well tolerated but encapsulated by fibrous tissue
- Biodegradable materials: Gradually resorbed and replaced by new tissue
- Bioinert materials: Exhibit minimal biological interaction

Based on Origin

- Natural biomaterials: Collagen, chitosan, alginate, silk fibroin
- Synthetic biomaterials: Bioceramics, synthetic polymers, metals and alloys

Based on Intended Use

- Bone grafts
- Barrier membranes
- Scaffolds and hydrogels
- Microspheres and drug delivery systems

Type of Graft	Source	Biological Properties	Advantages	Limitations
Autograft	Patient's own bone (intraoral / extraoral)	Osteogenic, osteoinductive, osteoconductive	Gold standard, no immunogenic reaction	Donor site morbidity, limited availability
Allograft (FDBA / DFDBA)	Human donor bone	Osteoconductive; DFDBA shows osteoinductive potential	No second surgical site, good availability	Disease transmission risk (minimal), variable inductivity
Xenograft	Animal source (commonly bovine)	Primarily osteoconductive	Excellent space maintenance, slow resorption	Limited remodeling, residual particles
Alloplast	Synthetic materials (HA, β-TCP, bioactive glass)	Osteoconductive	Unlimited supply, no disease risk	Inferior biologic activity compared to autografts

Table 1. Types of Bone Graft Materials Used in Periodontal Regeneration

Sources of Biomaterials

Biomaterials used in periodontal therapy originate from metals, non-metallic inorganics, polymers, and bio-derived matrices. Calcium phosphate ceramics and bioactive glasses are widely used due to their osteoconductive and osteoinductive properties. Polymers and hydrogels provide flexibility, controlled degradation, and compatibility with soft tissues, while bio-derived extracellular matrix materials offer biomimetic environments conducive to tissue regeneration.

Periodontal Biomaterials and Clinical Applications

Bone Graft Materials

Bone grafts remain the cornerstone of periodontal regeneration. These include autografts, allografts, xenografts, and alloplastic materials. Each category exhibits distinct biological behavior, advantages, and limitations.

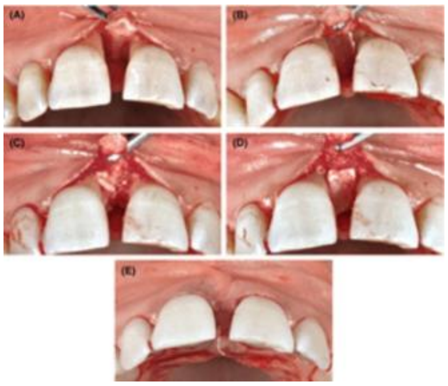

Figure 2 : Placement of freeze dried bone allograft (FDBA) in an intrabony periodontal defect.

Barrier Membranes

Guided tissue regeneration relies on barrier membranes to exclude epithelial migration and allow selective repopulation of periodontal defects by regenerative cells. Both resorbable and non-resorbable membranes are used clinically.

Biologically Active Materials

Enamel matrix derivatives, growth factors, and platelet concentrates enhance cellular proliferation, angiogenesis, and matrix formation, thereby improving regenerative outcomes.

Biomaterial	Form	Primary Function	Clinical Application
Collagen membranes	Resorbable membrane	Barrier function, cell exclusion	Guided tissue regeneration (GTR)
Hydroxyapatite / β - TCP	Granules / blocks	Scaffold, osteoconduction	Intrabony defects, ridge augmentation
Enamel matrix derivatives (EMD)	Gel	Biological stimulation of PDL cells	Intrabony defects, recession coverage
Platelet -rich fibrin (PRF)	Fibrin clot / membrane	Growth factor delivery, wound healing	Defect fill, soft tissue regeneration
Polymeric scaffolds	3D scaffold / hydrogel	Cell support, controlled degradation	Periodontal tissue engineering

Table 2. Commonly Used Biomaterials in Periodontal Regeneration and Their Clinical Applications

Recent Advances in Periodontal Biomaterials

Emerging strategies focus on smart biomaterials capable of responding to biological stimuli, immunomodulatory scaffolds, multilayered constructs, and controlled drug delivery systems. Advances in nanotechnology and three dimensional scaffold fabrication have enabled more precise mimicry of native periodontal tissues.

Future Challenges and Perspectives

Despite technological advancements, complete and predictable periodontal regeneration remains elusive. Challenges include controlling inflammation, achieving synchronized regeneration of multiple tissues, and ensuring long-term clinical stability. Future research should emphasize translational studies, personalized biomaterials, and integration of biological and mechanical cues.

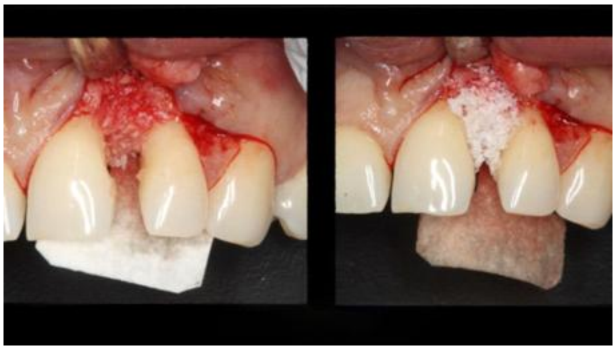

Figure 3 : Guided tissue regeneration using a resorbable membrane covering a grafted periodontal defect.

Conclusion

Biomaterials have revolutionized periodontal therapy by enabling regenerative approaches that were previously unattainable. Continuous innovations in material design, tissue engineering, and biological modulation hold promise for achieving predictable and functional periodontal regeneration. However, further clinical validation and long-term studies are essential before these advanced biomaterials can be routinely adopted in clinical practice.

References

1. Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. Nat Rev Dis Primers. 2017; 3: 17038.
2. Eke PI, Dye BA, Wei L, Slade GD, Thornton-Evans GO, Borgnakke WS, et al. Update on prevalence of periodontitis in adults in the United States. J Periodontol. 2015; 86 (5): 611–22.
3. Page RC, Kornman KS. The pathogenesis of human periodontitis: an introduction. Periodontol 2000. 1997; 14: 9–11.
4. Graves DT, Cochran D. The contribution of interleukin-1 and tumor necrosis factor to periodontal tissue destruction. J Periodontol. 2003; 74 (3): 391–401.
5. Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, et al. A new classification scheme for periodontal and peri-implant diseases and conditions. J Periodontol. 2018; 89 (Suppl 1): S1–8.
6. Sculean A, Nikolidakis D, Schwarz F. Regeneration of periodontal tissues: combinations of barrier membranes and grafting materials biological foundation and preclinical evidence. J Clin Periodontol. 2008; 35 (8 Suppl): 106–16.
7. Mellonig JT. Freeze-dried bone allografts in periodontal reconstructive surgery. Dent Clin North Am. 1991; 35 (3): 505–20.
8. Reynolds MA, Aichelmann-Reidy ME, Branch-Mays GL. Regeneration of periodontal tissue: bone replacement grafts. Dent Clin North Am. 2010; 54 (1): 55–71.
9. Bottino MC, Thomas V, Schmidt G, Vohra YK, Chu TM, Kowolik MJ, et al. Recent advances in the development of GTR/GBR membranes for periodontal regeneration. Dent Mater. 2012; 28 (7): 703–21.
10. Sheikh Z, Hamdan N, Ikeda Y, Grynpas M, Ganss B, Glogauer M. Natural graft tissues and synthetic biomaterials for periodontal and alveolar bone reconstructive applications: a review. Biomaterials. 2017; 26 (2): 163–84.
11. Miron RJ, Fujioka-Kobayashi M, Bishara M, Zhang Y, Hernandez M, Choukroun J. Platelet rich fibrin and soft tissue wound healing: a systematic review. Tissue Eng Part B Rev. 2017; 23 (1): 83–99.
12. Sculean A, Chapple ILC, Giannobile WV. Wound models for periodontal and bone regeneration: the role of biologic research. Periodontol 2000. 2015; 68 (1): 7–20.
13. Ivanovski S, Vaquette C, Gronthos S, Hutmacher DW, Bartold PM. Multiphasic scaffolds for periodontal tissue engineering. J Dent Res. 2014; 93 (12):1212–21.
14. Liang Y, Luan X, Liu X. Recent advances in periodontal regeneration: a biomaterial perspective. Bioact Mater. 2020; 5 (2): 297–308.
15. Chen H, Song G, Xu T, Meng C, Zhang Y, Xin T, et al. Advances in biomaterial scaffolds for periodontal tissue regeneration. Front Bioeng Biotechnol. 2024;12:1298743.

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Oral Potentially Malignant Disorders: Current Concepts in Classification, Etiopathogenesis, and Malignant Transformation – A Narrative Review

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Abstract

Background: Oral potentially malignant disorders (OPMDs) comprise a heterogeneous group of mucosal abnormalities associated with an increased risk of progression to oral squamous cell carcinoma (OSCC). The evolution of terminology, understanding of etiopathogenesis, and refinement of diagnostic criteria have significantly improved risk stratification and clinical management.

Objective: To comprehensively review the historical evolution, classification systems, clinicopathological features, molecular events, and malignant transformation potential of major oral potentially malignant disorders.

Materials and Methods: A narrative review was prepared using peer-reviewed literature compiled for a postgraduate library dissertation. Data sources included WHO consensus documents, epidemiological studies, clinicopathological analyses, and molecular investigations related to OPMDs.

Results: OPMDs represent a "field cancerization" phenomenon influenced by environmental carcinogens, genetic susceptibility, and immune dysregulation. Leukoplakia, proliferative verrucous leukoplakia, oral submucous fibrosis, and oral lichen planus demonstrate variable malignant transformation rates, influenced by clinical presentation, histological dysplasia, molecular alterations, and patient-related factors.

Conclusion: Early identification, standardized classification, and histopathological grading remain the cornerstone for predicting malignant transformation. Integration of molecular biomarkers may enhance future diagnostic precision and individualized management strategies.

Keywords: Oral potentially malignant disorders, Leukoplakia, Oral submucous fibrosis, Oral lichen planus, Malignant transformation, Oral epithelial dysplasia.

Introduction

Oral potentially malignant disorders (OPMDs) encompass a group of oral mucosa labnormalities that carry a statistically increased risk of malignant transformation. The terminology "OPMD" was formally adopted following the World Health Organization workshop in 2005 to replace the misleading terms precancerous lesions and precancerous conditions, acknowledging that not all such lesions progress to carcinoma, yet all possess malignant potential. OPMDs are of significant public health importance, particularly in the Indian subcontinent, where tobacco use, areca nut chewing, and betel quid consumption are highly prevalent. Despite advancements in treatment modalities, delayed diagnosis remains common due to limited public awareness and inadequate early detection strategies.

Historical Perspective and Terminology Evolution

The concept of precancer dates back to the early 19th century, with Victor Babes introducing the term "precancer" in 1875. The 1978 WHO classification divided oral pre cancer into precancerous lesions and precancerous conditions. However, conceptual ambiguity led to the adoption of the unified term oral potentially malignant disorders in 2005, later reaffirmed by WHO collaborating groups in 2020. This paradigm shift recognizes the dynamic biological continuum between normal mucosa and invasive carcinoma, influenced by genetic and environmental factors.

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Classification of Oral Potentially Malignant Disorders

WHO-Recognized OPMDs (2020)

- Leukoplakia
- Proliferative verrucous leukoplakia
- Erythroplakia
- Oral submucous fibrosis
- Oral lichen planus
- Actinic cheilitis
- Palatal lesions of reverse smoking
- Discoid lupus erythematosus
- Dyskeratosis congenita
- Oral graft-versus-host disease

WHO category	Oral potentially malignant disorder	Relative risk of malignant transformation
Keratotic disorders	Leukoplakia Proliferative verrucous leukoplakia	Low Intermediate High
Erythematous disorders	Erythroplakia	Very high
Fibrotic disorders	Oral submucous fibrosis	Intermediate High
Immune-mediated disorders	Oral lichen planus (erosive/atrophic types)	Low Intermediate
Actinic lesions	Actinic cheilitis	Intermediate
Habit-associated lesions	Palatal lesions in reverse smokers	Intermediate
Autoimmune disorders	Discoid lupus erythematosus	Low Intermediate
Genetic disorders	Dyskeratosis congenita	High
Transplant-related disorders	Oral graft-versus-host disease	Intermediate
Other disorders	Oral lichenoid lesions	Low

Table 1 WHO classification of oral potentially malignant disorders and associated risk categories

Etiopathogenesis and Field Cancerization

OPMDs represent genetically altered epithelial "fields" subjected to chronic carcinogenic exposure. Tobacco-related nitrosamines, areca nut alkaloids, alcohol-induced mucosal permeability, ultraviolet radiation, immune dysregulation, and genetic susceptibility contribute to epithelial dysplasia and malignant progression.

Molecular events documented in OPMDs include:

- p53 mutations
- Loss of heterozygosity (3p, 9p)
- Microsatellite instability
- Epigenetic alterations (DNA methylation)
- Increased telomerase activity

Major Oral Potentially Malignant Disorders

Oral Leukoplakia

Leukoplakia remains the most prevalent OPMD. Clinically classified into homogeneous and non-homogeneous variants, malignant transformation is strongly associated with non-homogeneous morphology, epithelial dysplasia, high-risk anatomical sites, and idiopathic lesions.

Figure: Homogeneous oral leukoplakia presenting as a well-demarcated, uniform white plaque on the buccal mucosa.

Proliferative Verrucous Leukoplakia

PVL is a distinct, aggressive subtype characterized by multi focal, progressive lesions with the highest malignant transformation rates among OPMDs. It predominantly affects elderly females and is often unrelated to tobacco exposure.

Figure: Proliferative verrucous leukoplakia showing a multifocal, irregular white plaque with verrucous surface involving the lateral border of the tongue.

Oral Submucous Fibrosis

OSF is a chronic, progressive fibrotic disorder strongly linked to areca nut chewing. Progressive collagen deposition leads to trismus, mucosal atrophy, and a malignant transformation rate ranging from 0.5% to 30%.

Oral Lichen Planus

OLP is a chronic immune-mediated mucocutaneous disorder. Erosive and atrophic variants exhibit higher malignant potential compared to reticular forms. Persistent inflammation and immune-mediated basal keratinocyte apoptosis contribute to carcinogenic risk.

Figure: Erosive oral lichen planus presenting as erythematous, ulcerated gingival lesions consistent with desquamative gingivitis.

Oral Epithelial Dysplasia and Malignant Transformation

Histopathological grading of oral epithelial dysplasia (OED) remains the gold standard for assessing malignant risk. The WHO 2017 binary and three-tier grading systems aim to improve reproducibility and clinical relevance. However, malignant transformation can occur even in the absence of dysplasia, underscoring the need for adjunctive biomarkers.

Feature	WHO 2005 grading system	WHO 2017 grading system	Clinical implications
Grading approach	Three-tier + CIS	Three-tier (simplified)	Improves diagnostic consistency
Dysplasia categories	Mild, Moderate, Severe, Carcinoma in situ	Mild, Moderate, Severe	CIS merged with severe dysplasia
Squamous hyperplasia	Included	Excluded	Reduces overdiagnosis
Carcinoma in situ	Separate category	Removed	Considered synonymous with severe dysplasia
Architectural criteria	Emphasis on epithelial thirds	Emphasis on architectural disturbance	Better reflects biological behavior
Cytological features	Included increased nuclear size	Nuclear size removed	Reduces subjectivity
Reproducibility	Moderate inter-observer variability	Improved reproducibility	Enhances reporting reliability
Risk stratification	Less precise	More clinically relevant	Aids treatment planning
Clinical decision-making	Conservative	Risk-based intervention	Improves patient management

Table 2 Comparison of WHO grading systems for oral epithelial dysplasia and their clinical implications

Discussion

The heterogeneous biological behavior of OPMDs necessitates individualized risk assessment and long-term surveillance. While epithelial dysplasia remains a key prognostic indicator, emerging molecular markers may refine future predictive models. Public health strategies focusing on habit cessation, patient education, and early screening are critical, particularly in high-risk populations.

Conclusion

Oral potentially malignant disorders represent a critical window of opportunity for cancer prevention. Standardized terminology, accurate diagnosis, and evidence based mana - gement strategies are essential to reduce OSCC-related morbidity and mortality. Continued research into molecular pathways and biomarkers holds promise for early detection and personalized therapeutic interventions.

References

1. Warnakulasuriya S, Johnson NW, van der Waal I. Nomenclature and classification of potentially malignant disorders of the oral mucosa. J Oral Pathol Med. 2007;36(10):575-80.
2. World Health Organization. WHO classification of head and neck tumours. 4th ed. Lyon: IARC Press; 2017.
3. World Health Organization Collaborating Centre for Oral Cancer. Oral potentially malignant disorders: Report of a consensus meeting. Oral Oncol. 2021;118:105366.
4. Speight PM, Khurram SA, Kujan O. Oral potentially malignant disorders: Risk of progression to malignancy. Oral Surg Oral Med Oral Pathol Oral Radiol. 2018;125(6):612-27.
5. Amarasinghe HK, Usgodaarachchi US, Johnson NW, Lalloo R, Warnakulasuriya S. Betel-quid chewing, alcohol consumption and oral potentially malignant disorders in Sri Lanka. J Oral Pathol Med. 2010;39(5):361-7.
6. Reibel J, Gale N, Hille J, Hunt JL, Lingen M, Muller S, et al. Oral epithelial dysplasia and carcinoma in situ. In: WHO classification of head and neck tumours. Lyon: IARC Press; 2017. p. 112-5.
7. Pentenero M, Navone R, Motta F, Marino R, Gassino L, Broccoletti R, et al. Clinical features and management of oral leukoplakia. Oral Oncol. 2003;39(4):402-8.
8. Lee JJ, Hong WK, Hittelman WN, Mao L, Lotan R, Shin DM, et al. Predicting cancer development in oral leukoplakia: Ten years of translational research. Clin Cancer Res. 2006;12(17):4956-63.
9. Villa A, Woo SB. Proliferative verrucous leukoplakia: A review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol. 2017;124(5):438-46.
10. Penternero M, Gandolfo S, Carrozzo M. Proliferative verrucous leukoplakia: A potentially aggressive form of oral leukoplakia. Oral Oncol. 2014;50(6):525-31.
11. Pindborg JJ, Murti PR, Bhonsle RB, Gupta PC, Daftary DK, Mehta FS. Oral submucous fibrosis as a precancerous condition. J Oral Pathol. 1984;13(3):252-69.
12. Gupta PC, Ray CS. Epidemiology of betel quid usage. Ann Acad Med Singap. 2004;33(4 Suppl):31-6.
13. More CB, Gupta S, Joshi J, Varma SN. Classification system for oral submucous fibrosis. J Oral Pathol Med. 2012;41(2):147-51.
14. Roopashree MR, Gondhalekar RV, Shashikanth MC, George J, Thippeswamy SH, Shukla A. Pathogenesis of oral lichen planus – A review. J Oral Pathol Med. 2010;39(10):729-34.
15. van der Meij EH, Schepman KP, van der Waal I. The possible premalignant character of oral lichen planus. J Oral Pathol Med. 2003;32(3):164-70.

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Intraoral Scanners in Contemporary Orthodontics: Principles, Applications, and Clinical Considerations

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Abstract

The integration of digital technologies has fundamentally transformed contemporary orthodontic practice. Among these innovations, intraoral scanners (IOS) have emerged as a cornerstone of digital work flows, replacing conventional impression techniques with optical data acquisition. Intraoral scanners enhance diagnostic accuracy, improve patient comfort, and streamline communication between clinicians and laboratories. This review critically appraises the evolution, imaging principles, accuracy, clinical applications, advantages, and limitations of intraoral scanners in orthodontics. Current evidence suggests that IOS systems demonstrate comparable or superior accuracy to conventional impressions for most clinical applications, although limitations related to cost, learning curve, and full-arch scanning accuracy persist. Understanding scanner technology and clinical requirements is essential for effective integration into orthodontic practice.

Keywords: Intraoral scanners, digital impressions, orthodontics, CAD/CAM, digital dentistry.

1. Introduction

Orthodontics is undergoing a para -digm shift with the incorporation of digital technologies into routine clinical practice. Traditional reliance on plaster casts, paper records, and physical storage has progressively given way to digital alternatives. Intraoral scanners (IOS) allow direct optical impressions, eliminating errors associated with impression materials and cast fabrication while offering immediate visualization and long-term data storage.

The introduction of CAD/CAM systems in the 1970s laid the foundation for digital dentistry, culminating in the widespread adoption of IOS technology. In orthodontics, IOS systems facilitate accurate diagnosis, treatment planning, appliance fabrication, and patient communication. Their expanding role necessitates a comprehensive under standing of their principles, performance, and clinical utility.

2. Historical Evolution of Intraoral Scanners

Digital impression technology traces its origins to the pioneering work of François Duret in the early 1970s. The introduction of the CEREC system in 1987 marked the first clinical application of digital impressions in restorative dentistry. The subsequent launch of full-arch scanning systems such as iTero significantly expanded the orthodontic applications of IOS technology.

Continuous advancements in optical imaging, processing algorithms, and ergo - nomic design have led to the development of multiple commercially available scanners, each offering unique features and clinical advantages.

3. Rationale for Digital Impression Systems

The transition from conventional to digital impression techniques mirrors earlier shifts seen with digital radiography and photo graphy. IOS systems offer enhanced patient comfort, reduced gag reflex, faster work flows, and improved clinical efficiency. Digital impressions also facilitate sustainable practice by minimizing material waste and reducing storage requirements.

Evidence indicates that digital impressions perform comparably or superiorly to conventional methods in most orthodontic applications, supporting their growing adoption.

4. Digital Versus Conventional Impression Techniques

Comparative studies evaluating IOS and conventional impressions have focused on accuracy, efficiency, patient experience, and reproducibility. Systematic reviews indicate that most modern IOS systems demonstrate

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clinically acceptable accuracy for orthodontic diagnosis and appliance fabrication.

Parameter	Conventional Impression	Digital Impression (IOS)
Patient comfort	Gag reflex, unpleasant taste	Better comfort, gag - free
Accuracy	Technique sensitive	High trueness and precision
Repeatability	Entire impression repeated	Localized rescanning
Workflow time	Longer clinical and lab time	Faster, streamlined workflow
Data handling	Physical casts, storage needed	Instant 3D digital records
Lab communication	Physical transfer	Immediate digital transfer

Table 1 Comparison of Conventional and Digital (Intraoral Scanner) Impression Techniques

5. Imaging Principles of Intraoral Scanners

Intraoral scanners employ various optical principles to acquire three-dimensional data:

5.1 Confocal Laser Scanning

Confocal laser scanning involves passing a laser beam through a small pinhole filter and directing it onto the target region. The imaging plane is accurately defined because it captures only light reflected from the focused region and excludes out-of-focus information. The whole three-dimensional structure of the scanned region may be properly reconstructed by obtaining two-dimensional pictures at numerous confocal planes in sequence.

This method of image acquisition is often referred to as "point-and-stitch reconstruction." The iTero and TRIOS intraoral scanners are prominent examples that utilize this technique.

5.2 Triangulation Technique

The triangulation technique has served as the foundation for the CEREC system. It consists of three main components: a laser emitter, a sensor, and the surface of the item being scanned. The scanner can properly estimate the geometry of the item surface by using the known distances and angles between these locations, as determined using the Pythagorean theorem. To improve detail and reduce light dispersion, a thin layer of radiopaque powder can be placed to the tooth surface, standardizing the texture.[3] An example of this is Optispray®, which is mostly constituted of titanium oxide and is widely used with CEREC systems.

5.3 Active Wave Front Sampling (3D-in-Motion Video Recording)

Active wave-front sampling is an optical technique in which three-dimensional information is captured using a single-lens imaging system. Depth measurements are obtained based on the defocus of the primary optics, allowing for continuous 3D data acquisition. This method is employed in the Lava Chairside Oral Scanner (COS) and the True Definition system, both of which utilize 3D-in-motion video recording technology to generate accurate digital impressions.

Three internal complementary metal-oxide-semiconductor (CMOS) sensors are used to capture three-dimensional information from various angles, resulting in image triplets.[4] This method not only improves scanning accuracy but also provides a high level of data redundancy, which helps to the dependability and precision of the reconstructed 3D model.

3M ESPE state that its active wave-front sampling has developed into 3D-in-motion technology, a next-generation approach with three essential components: real-time model reconstruction, innovative image processing algorithms, and active wave-front sampling. To act as a connector for location reference, a little coating of powder dusting is advised prior to scanning.

Each technique influences accuracy, scanning depth, and clinical performance. Understanding these principles aids clinicians in selecting an appropriate scanner based on clinical needs.

6. Data Acquisition and Digital Workflow

IOS technology integrates seamlessly with laboratory scanners, CBCT data, and facial scanning systems, enabling comprehensive digital workflows. Structured light and blue light scanning systems are commonly used due to their superior accuracy and resistance to ambient light interference.

Figure 1 Clinical intraoral scanning procedure showing real-time digital impression acquisition

7. Accuracy, Precision, and Clinical Performance

Accuracy comprises trueness and precision. While most IOS systems demonstrate high precision in vivo, accuracy may decrease with increasing scan area, particularly in full-arch scans. Moisture control, scanning strategy, and operator experience significantly influence outcomes.

Studies indicate that partial-arch scans are generally more accurate than full-arch scans, although technological improvements continue to narrow this gap.

8. Commercially Available Intraoral Scanners

Several IOS systems dominate the clinical market, including iTero, TRIOS, CEREC, and True Definition scanners. These systems differ in imaging principles, ergonomics, scanning speed, software integration, and cost.

Scanner	Manufacturer	Imaging Principle	Key Advantages	Limitations
iTero Element	Align Technology	Confocal laser scanning	High accuracy, Invisalign compatibility, powder-free	Bulky wand, high cost
TRIOS 3	3Shape	Confocal laser scanning	High scanning speed, autoclavable tips	Expensive, calibration cost
TRIOS 4	3Shape	Confocal laser + fluorescence	Improved accuracy, caries detection, Colour scan	Limited Invisalign compatibility
TRIOS 5 True Definition	3Shape	Confocal laser + AI	Smaller, lighter, faster scanning	High cost, limited tip lifespan
CEREC Omnicam	Dentsply Sirona	Triangulation	Continuous video capture, powder-free	Bulky, costly
Primescan	Dentsply Sirona	Dynamic deep scan	Very high accuracy, fast scanning	Expensive, limited portability

Table 2. Comparison of Commonly Used Intraoral Scanners in Orthodontics

9. Clinical Applications in Orthodontics

Intraoral scanners support a wide range of orthodontic applications, including:

- Digital study models
- Virtual treatment setups
- Indirect bonding trays
- Clear aligner fabrication
- Retainer production
- Progress monitoring and outcome simulation

Digital workflows enhance communication between clinicians, technicians, and patients, improving treatment predictability and acceptance.

Figure 2 Digitally generated orthodontic model used for treatment planning and appliance fabrication

10. Limitations and Considerations

Despite their advantages, IOS systems present challenges including high initial costs, annual maintenance fees, learning curves, and dependence on reliable digital infrastructure. Scanner accuracy may also be compromised in the presence of saliva, reflective surfaces, and extensive edentulous areas.

Careful evaluation of clinical requirements, ergonomics, software compatibility, and long-term costs is essential before adoption.

11. Conclusion

Intraoral scanners represent a transformative advancement in orthodontic practice, offering improved efficiency, accuracy, and patient-centered care. While limitations persist, ongoing technological developments continue to expand their clinical reliability and applications. With appropriate training and system selection, IOS technology can be effectively integrated into modern orthodontic workflows, supporting precision-driven and digitally enhanced patient care.

References

1. Mangano F, Gandolfi A, Luongo G, Logozzo S. Intraoral scanners in dentistry: a review of the current literature. BMC Oral Health. 2017;17:149.
2. Ender A, Mehl A. Accuracy of complete-arch dental impressions: a new method of measuring trueness and precision. J Prosthet Dent. 2013;109(2):121–128.
3. Goracci C, Franchi L, Vichi A, Ferrari M. Accuracy, reliability, and efficiency of intraoral scanners for full-arch impressions: a systematic review of the clinical evidence. Eur J Orthod. 2016;38(4):422–428.
4. Aragón ML, Pontes LF, Bichara LM, Flores-Mir C, Normando D. Validity and reliability of intraoral scanners compared to conventional gypsum models measurements: a systematic review. Eur J Orthod. 2016;38(4):429–434.
5. Patzelt SB, Lamprinos C, Stampf S, Att W. The time efficiency of intraoral scanners: an in vitro comparative study. J Am Dent Assoc. 2014;145(6):542–551.
6. Ender A, Attin T, Mehl A. In vivo precision of conventional and digital methods of obtaining complete-arch dental impre ssions. J Prosthet Dent. 2016;115(3):313–320.
7. Fleming PS, Marinho V, Johal A. Orthodontic measurements on digital study models compared with plaster models: a systematic review. Orthod Craniofac Res. 2011;14(1):1–16.
8. Grunheid T, McCarthy SD, Larson BE. Clinical use of a direct chairside oral scanner: an assessment of accuracy, time, and patient acceptance. Am J Orthod Dentofacial Orthop. 2014;146(5):673–682.
9. Naidu D, Freer TJ. Validity, reliability, and reproducibility of the iOC intraoral scanner: a comparison of tooth widths and Bolton ratios. Am J Orthod Dentofacial Orthop. 2013; 144 (2) :304–310.
10. Zimmermann M, Mehl A, Mörmann WH, Reich S. Intraoral scanning systems-A current overview. Int J Comput Dent. 2015;18(2):101–129.
11. Logozzo S, Zanetti EM, Franceschini G, Kilpelä A, Mäkynen A. Recent advances in dental optics—Part I: 3D intraoral scanners for restorative dentistry. Opt Lasers Eng. 2014;54:203–221.
12. Christensen GJ. The challenge to conventional impressions. J Am Dent Assoc. 2008;139(3):347–349.
13. Richert R, Goujat A, Venet L, et al. Intraoral scanner technologies: a review to make a successful impression. J Healthc Eng. 2017;2017:8427595.
14. Jung YR, Park JM, Chun YS, Lee KN, Kim M. Accuracy of four different digital intraoral scanners: effects of orthodontic brackets and wire. Int J Comput Dent. 2016;19(3):203–215.
15. Christopoulou I, Kaklamanos EG, Makrygiannakis MA, Bitsanis I, Tsolakis AI. Patient-reported experiences and preferences with intraoral scanners: a systematic review. Eur J Orthod. 2022;44(1):56–65.

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Laser Assisted Excision of Intra-oral Capillary Hemangioma: A Case Report

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Abstract

Hemangiomas are benign vascular neoplasms originating from blood vessels. They present as elevated or flat reddish blue lesions and are usually solitary, predominantly affecting younger women. The growth may progress slowly, involving both superficial and deep vascular structures, and may impair function depending on its location. While most commonly seen in the head and neck region, oral involvement is rare. This case report aims to assess the efficacy of laser therapy in managing capillary hemangioma. The Nd: YAG laser offers superior hemostasis, precise tissue removal, minimal postoperative pain, faster healing, and improved patient compliance, making it a favourable alternative to conventional surgical techniques.

Introduction

Hemangiomas are developmental vascular anomalies and are considered by many authors to be benign lesions originating from endothelial cells.[1] They are broadly categorised according to the type of blood vessels involved into capillary and cavernous variants. Capillary hemangioma is the most prevalent form, typically presenting as a small, localised lesion with relatively non-aggressive clinical behaviour. In contrast, cavernous hemangioma represents a more aggressive variant, often producing infiltrative lesions. The pathogenesis of hemangiomas is largely attributed to genetic and cellular mechanisms.[2] Dysregulation of angiogenesis, leading to uncontrolled proliferation of vascular components, along with elevated levels of factors such as vascular endothelial growth factor, basic fibroblast growth factor, and indoleamine 2,3-dioxygenase during the proliferative phase, is believed to play a key role.[3]

Hemangiomas account for about 60%–70% lesions in the head and neck region. Clinically, these lesions appear as soft, smooth, or lobulated growths that may be either sessile or pedunculated, with dimensions ranging from a few millimetres to several centimetres.[4] The colour commonly ranges from pink to reddish-purple and may arise spontaneously or following minor trauma. Although most lesions are self-resolving, some may become symptomatic and necessitate treatment. Therapeutic modalities include surgical removal, cryotherapy, embolisation, laser-based therapy, and corticosteroid use.[5]

Oral hemangiomas are most frequently encountered on the gingiva and less commonly at other sites, including the palate, buccal mucosa, alveolar ridge, and salivary glands.[6] Lesions involving the labial mucosa can lead to multiple complications due to their proneness to trauma, resulting in cosmetic disfigurement, repeated hemorrhagic episodes, and functional impairments affecting speech and mastication. This article presents the case of a 24-year-old female patient with a painless swelling of the labial mucosa, which was confirmed histopathologically as a capillary hemangioma and managed appropriately.

Case Report

A male patient aged 24 years reported to the Department of Periodontology, Santosh Dental College, Ghaziabad, UP, with a painless enlargement on the left labial mucosa in relation to the central–lateral incisors region in the last 7 months. A comprehensive intraoral examination revealed soft tissue overgrowth [Figure 1], which was pink in colour, soft in consistency, nonpulsatile on palpation, and sessile in origin, arising from the labial mucosa in relation to 41-42 region.

The margin of the lesion is about 6.5 mm × 5.5 mm in diameter with no secondary

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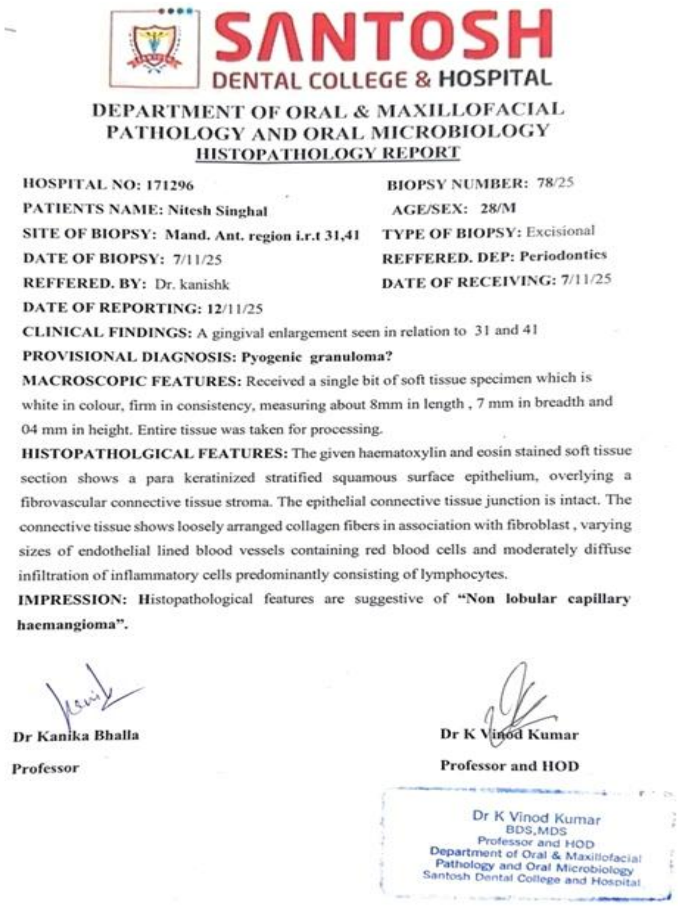
ulcerations or bleeding. The oral hygiene was reasonably good. Medical history non-contributory. A provisional diagnosis of fibroma was made based on the clinical resemblance and the assumption that the patient was undergoing orthodontic treatment. Differential diagnosis: Pyogenic granuloma, lipoma, peripheral giant cell granuloma. Preoperative haematological test revealed all the relevant findings to be normal. The treatment plan included complete scaling followed by excision of the lesion using soft tissue Nd: YAG laser as a confirmatory diagnosis was yet to be elucidated. The lesion was excised under 2% lignocaine with 1:80,000 adrenaline under the soft tissue laser of 1064 nm, under the settings of 2.5 watts, contact, and pulsed mode. [Figures 2]. An excisional biopsy was thus made for histopathological examination. [Figure 3]. The excised lesion was sent for histopathological examination after fixing in 10% neutral buffered formalin. The hematoxylin and eosinstained soft tissue section showed lobulated cellular growth, which is divided by fibrillar connective tissue composed of loose bundles of collagen fibres. They contain proliferating endothelial cells in combination with numerous well and poorly canalised blood vessels. The overlying epithelium is a parakeratotic stratified type. It is sparsely infiltrated with chronic inflammatory cells, predominantly lymphocytes. Based on clinical examination and histopathology, a confirmatory diagnosis of lobulated capillary hemangioma was made. [Figure 4]. The patient was recalled within 10 days for post-operative follow-up, and satisfactory, uneventful healing was seen.[Figure 5] The patient is under follow-up to monitor the recurrence.

Figure 1: Pre-operative

Figure 2: Laser-assisted Excision of Capillary Hemangioma

Figure 3: Excised Tissue for Histopathological Examination



SANTOSH
DENTAL COLLEGE & HOSPITAL

DEPARTMENT OF ORAL & MAXILLOFACIAL PATHOLOGY AND ORAL MICROBIOLOGY

HISTOPATHOLOGY REPORT

HOSPITAL NO: 171296 BIOPSY NUMBER: 78/25
PATIENTS NAME: Nitesh Singhal AGE/SEX: 28/M
SITE OF BIOPSY: Mand. Ant. region i.r.t 31,41 TYPE OF BIOPSY: Excisional
DATE OF BIOPSY: 7/11/25 REFFERED. DEP: Periodontics
REFFERED. BY: Dr. kanishk DATE OF RECEIVING: 7/11/25
DATE OF REPORTING: 12/11/25

CLINICAL FINDINGS: A gingival enlargement seen in relation to 31 and 41

PROVISIONAL DIAGNOSIS: Pyogenic granuloma?

MACROSCOPIC FEATURES: Received a single bit of soft tissue specimen which is white in colour, firm in consistency, measuring about 8mm in length , 7 mm in breadth and 04 mm in height. Entire tissue was taken for processing.

HISTOPATHOLGICAL FEATURES: The given haematoxylin and eosin stained soft tissue section shows a para keratinized stratified squamous surface epithelium, overlying a fibrovascular connective tissue stroma. The epithelial connective tissue junction is intact. The connective tissue shows loosely arranged collagen fibers in association with fibroblast , varying sizes of endothelial lined blood vessels containing red blood cells and moderately diffuse infiltration of inflammatory cells predominantly consisting of lymphocytes.

IMPRESSION: Histopathological features are suggestive of "Non lobular capillary haemangioma".

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Professor and HOD

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Figure 4: Biopsy Report

Figure 5: 10 Days Post-operative

Discussion

Haemangiomas are considered hamartomatous lesions rather than true tumours.[7] They most commonly occur in the head and neck region, with infrequent involvement of the oral cavity.[8] Oral haemangiomas may manifest as small or large surface enlargements with varying levels of soft-tissue invasion, or as extensive lesions extending into the oesophagus. They may also present as multicentric lesions with a cobblestone-like appearance.[8] The majority of small, superficial lesions, particularly those that are pedunculated, are capillary haemangiomas, whereas larger superficial or deeply located lesions are generally cavernous or of mixed histological types.[9] Due to their rarity, these lesions can clinically, radiographically, and occasionally histopathologically resemble other conditions, resulting in diagnostic uncertainty.

Vascular lesions can be divided into those characterised by endothelial proliferation (hemangiomas) and those with normal endothelial turnover (vascular malformations). Although hemangioma is considered one of the most common soft tissue tumours of the head and neck, it is relatively rare in the oral cavity and is uncommonly encountered by clinicians.[10] On the basis of the history given by the patient and the clinical examination, a provisional diagnosis of fibroma was made. A multitude of other lesions in the oral cavity can be resembled as hemangiomas, with the differential diagnoses comprising pyogenic granuloma (PG), chronic inflammatory gingival hyperplasia, epulis granulomatosa, telangiectasia, angiosarcoma, squamous cell carcinoma, and other vascular appearing lesions of the face or oral cavity, such as Sturge Weber syndrome.[11] Therefore, microscopic evaluation is mandatory to come to a definitive diagnosis.

Pyogenic granuloma (PG) and hemangiomas can pose a diagnostic challenge for clinicians due to overlapping clinical features and a higher prevalence in females. Histologically, PG is categorized into two types: lobular capillary hemangioma (LCH) and non-LCH. The LCH variant is characterized by a thin endothelial lining surrounded by uniform proliferation of plump to spindle-shaped cells, whereas capillary hemangioma exhibits more prominent endothelial cells and a network of capillary-sized vessels arranged in a lobular pattern. In LCH-type PG, the capillaries are often oriented perpendicular to the surface. In contrast, fibromas demonstrate dense connective tissue with fewer budding capillaries compared to capillary hemangiomas. Considering the histopathological features along with clinical evaluation, a definitive diagnosis of capillary hemangioma was established.[12]

Surgical removal of hemangiomas requires caution due to the risks of excessive bleeding and possible recurrence. Modern treatment options include steroids, electrosurgery, laser therapy, cryosurgery, and sclerotherapy, the latter being favoured for preserving adjacent tissues.[13]

In this case, a soft-tissue Nd: YAG laser (1064 nm) was used based on clinical assessment. Nd: YAG lasers are popular in dentistry for their compact size, affordability, fibre-optic delivery, and ease of use. Nd: YAG lasers have been shown to reduce intraoperative bleeding, shorten procedure time, and ensure rapid postoperative hemostasis, with minimal complications such as scarring or discomfort.

Conclusion

Hemangiomas are common benign vascular proliferations; however, their infrequent occurrence makes it essential for dental practitioners to perform thorough clinical assessment and necessary investigations. Clinicians must be knowledgeable about the clinical presentation and management strategies for hemangiomas, taking precautions before surgical intervention due to the risk of sudden and excessive bleeding. Capillary hemangiomas frequently resemble pyogenic granulomas, requiring accurate diagnosis and appropriate treatment. Conventional surgical excision may result in significant haemorrhage, making laser excision a safer alternative.

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Conflicts of Interest

There are no conflicts of interest

Referees

1. Purkait SK. Essentials of Oral Pathology. Benign and Malignant Neoplasms of the Oral Cavity. JP Medical Ltd; New Delhi, India. 2011. p. 1201.
2. Neville BW, Damm DD, Allen CM, Bouquot JE. Oral & Maxillo facial Pathology. 2nd ed. India: Elsevier; 2002. p. 467–71.
3. Shafer WG, Hire MK, Levy BM. A textbook of oral pathology. 4th ed. Philadelphia: WB Saunders Co; 1983. pp. 154–157.
4. Enzinger FM, Weiss SW. Soft Tissue Tumours. 3rd ed. St. Louis: Mosby; 1995. p. 5816.
5. Avila ED, Molon RS, Conte Neto N, Gabrielli MA, HochuliVieira E. Lip cavernous hemangioma in a young child. Braz Dent J 2010;21:3704.
6. Lanza A, Gombos F. A case of multiple oral vascular tumours: The diagnostic challenge on haemangioma remains open. J Stomatol Investig 2008;2:6771.
7. Singh P, Parihar AS, Siddique SN, Khare P. Capillary haemangioma on the palate: a diagnostic conundrum. BMJ Case Rep. 2016;2016:bcr2015210948.
8. Nazeri R, Ghaiour M. Management of an elevated soft-tissue lesion with diagnosis of capillary hemangioma. SRM J Res Dent Sci. 2018;9(1):48–51.
9. Kumari VR, Vallabhan CG, Geetha S, Nair MS, Jacob TV. Atypical presentation of capillary hemangioma in oral cavity- a case report. J Clin Diagn Res. 2015;9(10): ZD26–8.
10. Kamala KA, Ashok L, Sujatha GP. Cavernous hemangioma of the tongue: A rare case report. Contemp Clin Dent 2014;5:958.
11. Dilsiz A, Aydin T, Gursan N. Capillary hemangioma as a rare benign tumor of the oral cavity: A case report. Cases J 2009;2:8622.
12. Bouquot JE, Nilai H. Lesions of the oral cavity. In: Gnepp DR, editor. Diagnostic Surgical Pathology of the Head and Neck. Philadelphia: WB Saunders; 2001. pp. 141–233.
13. Mulliken JB. Cutaneous vascular anomalies. In: McCarthy JG, editor. Plastic Surgery: Tumors of Head and Neck and Skin. Vol. 5. Philadelphia, PA: W.B Saunders Company Ltd.: 1990. p. 3194-230

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Biomimetic Approaches in Restorative Dentistry

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Abstract

Biomimetics in restorative dentistry focuses on replicating the biological, mechanical, and esthetic characteristics of natural dental tissues to achieve restorations that are functionally integrated and long lasting. Conventional restorative approaches often emphasize mechanical replacement of tooth structure, leading to excessive removal of healthy tissues, microleakage, secondary caries, and premature restoration failure. Biomimetic dentistry represents a paradigm shift toward tissue preservation, biological integration, and regeneration. This review analyzes the evolution, classification, properties, and clinical applications of biomimetic materials used in restorative and endodontic dentistry. Bioinert materials such as stainless steel and conventional nickel titanium alloys, bioactive materials including mineral trioxide aggregate, Biodentine, and Bioaggregate, and bioresorbable materials such as bioceramic sealers and bioactive glass are discussed in detail. Biomimetic materials demonstrate superior sealing ability, biocompatibility, antimicrobial properties, and the capacity to stimulate hard tissue regeneration. Despite challenges such as cost, handling complexity, and retreatment difficulties, biomimetic approaches are transforming restorative dental practice. Continued research is expected to yield advanced smart biomaterials with enhanced biological responsiveness and mechanical integration, further revolutionizing dental therapy.

Keywords: Biomimetics, Restorative dentistry; Bioactive materials; Bioinert materials; Bioceramics; Mineral trioxide aggregate; Biodentine; Bioactive glass; Vital pulp therapy; Endodontics

Introduction

Biomimetics refers to the design and development of materials and systems inspired by biological structures and processes found in nature. In dentistry, biomimetic principles are applied to recreate the structure, composition, and function of natural dental tissues with the objective of restoring teeth while preserving biological integrity and mechanical performance[1]. The term "biomimetics" was introduced by Otto Schmitt in the 1950s and is derived from the Greek words *bios* (life) and mimetikos (to imitate)[2].

Conventional restorative dentistry has historically relied on mechanically retentive cavity designs and rigid restorative materials, often resulting in unnecessary removal of sound tooth structure. Such approaches compromise tooth biomechanics and predispose restorations to microleakage, recurrent caries, cuspal deflection, and eventual failure[3]. In contrast, biomimetic restorative dentistry emphasizes conservative preparation, adhesive techniques, and materials that interact biologically with dentin and pulp tissues[4].

Magne described biomimetic dentistry as the application of advanced adhesive protocols and restorative materials that respect the biological, structural, and mechanical properties of enamel and dentin[5]. Bioactive materials elicit specific biological responses at the material tissue interface, whereas bioinert materials remain passive within the biological environment[6]. This review presents a comprehensive analysis of the historical background, classification, material properties, and clinical applications of biomimetic materials in conservative and endodontic dentistry.

Materials and Methods

A systematic literature review was conducted using electronic databases including PubMed, NCBI, Google Scholar, and the International Journal of Dentistry. Articles published in English focusing on biomimetic

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materials in restorative and endodontic dentistry were included. Peer-reviewed original research articles, randomized clinical trials, systematic reviews, and case reports were considered eligible[7].

Articles were excluded if they were non-English publications, incomplete reports, or lacked scientific validation. The reviewed materials were categorized into three major groups:

1. Bioinert materials, which provide mechanical support without biological interaction.
2. Bioactive materials, which stimulate biological responses and tissue regeneration.
3. Bioresorbable materials, which gradually resorb while promoting natural tissue healing.

Each material was evaluated based on composition, setting mechanism, mechanical properties, biological behavior, clinical indications, advantages, and limitations.

Results

Bioinert Materials

Stainless Steel

Stainless steel represents one of the earliest biomaterials used in restorative dentistry and endodontics. Composed primarily of iron, chromium, and nickel, stainless steel offers excellent corrosion resistance, rigidity, and affordability[8]. It has historically been used for hand instruments, crowns, and orthodontic appliances.

Despite its mechanical strength, stainless steel lacks flexibility and exhibits a tendency to straighten within curved root canals, increasing the risk of canal transportation, ledging, and perforation[9]. From a biomimetic perspective, stainless steel serves purely mechanical purposes and does not interact biologically with dental tissues.

Nickel–Titanium Alloys

Nickel titanium (NiTi) alloys revolutionized endodontics due to their superelasticity and shape memory properties, resulting from reversible martensite austenite phase transformation[10]. These properties enable NiTi instruments to conform to complex canal anatomy while reducing stress on dentinal walls.

Advancements such as M-Wire, controlled memory (CM) wire, and HyFlex EDM have improved flexibility, cyclic fatigue resistance, and fracture toughness[11]. Electrical discharge machining produces a hardened surface layer that enhances durability. However, despite superior mechanical performance, NiTi alloys remain bioinert and do not contribute to tissue regeneration[12].

Bioactive and Bioresorbable Materials

Mineral Trioxide Aggregate (MTA)

Mineral trioxide aggregate is one of the earliest and most widely used bioactive materials in restorative and endodontic dentistry. Composed primarily of tricalcium silicate, dicalcium silicate, and bismuth oxide, MTA releases calcium ions during hydration, promoting hydroxyapatite formation at the dentin interface[13].

MTA demonstrates excellent sealing ability, biocompatibility, and antimicrobial properties, making it suitable for direct pulp capping, pulpotomy, apexification, perforation repair, and root-end filling[14]. However, drawbacks include prolonged setting time, difficult handling, and potential discoloration[15].

Biodentine

Biodentine was developed as an improved calcium silicate-based dentin substitute. It exhibits a significantly shorter setting time (approximately 12 minutes) and high compressive strength comparable to natural dentin[16]. Biodentine releases calcium ions that stimulate reparative dentin formation and maintain pulp vitality.

Clinical applications include direct and indirect pulp capping, pulpotomy, apexification, and perforation repair. Studies demonstrate superior dentinal bridge quality and reduced inflammation compared to calcium hydroxide[17].

Bioaggregate

Bioaggregate is a modified tricalcium silicate material that excludes aluminum and incorporates phosphate components to enhance bioactivity and biocompatibility[18]. It promotes hydroxyapatite formation and exhibits favorable sealing ability, making it suitable for vital pulp therapy and root repair procedures.

Bioactive Glass

Bioactive glass consists of calcium sodium phosphosilicate and exhibits bioactivity through the formation of an apatite-like layer upon contact with body fluids[19]. The release of alkaline ions increases local pH, inhibiting bacterial growth.

Bioactive glass has been widely used in desensitizing toothpastes, air-polishing powders, bone grafts, and emerging endodontic applications[20].

Bioceramic Sealers

Bioceramic sealers have gained popularity due to their bioactivity, dimensional stability, and ability to form chemical bonds with dentin.

- EndoSequence BC Sealer forms hydroxyapatite during setting and exhibits excellent sealing and biocompatibility[21].
- MTA Fillapex combines MTA with resin but demonstrates higher solubility and lower bond strength[22].
- ERRM Putty and Paste offer premixed, moldable consistency with superior biological sealing[23].

Ceramir

Ceramir is a calcium aluminate-based cement used primarily as a luting agent. It combines the advantages of glass ionomer and bioceramic technology, providing biocompatibility, alkaline pH, and durable adhesion to tooth structure[24].

Clinical Applications

Vital Pulp Therapy

MTA and Biodentine show high success rates in pulp capping and pulpotomy, supporting reparative dentinogenesis and long-term pulp vitality[25].

Apexogenesis and Apexification

Bioactive materials facilitate apical barrier formation and continued root development in immature teeth without producing necrotic byproducts[26]

Perforation Repair

MTA and calcium-enriched mixture cement effectively promote cementogenesis and periodontal healing in perforation defects[27].

Root-End Filling and Obturation

Bioceramic sealers provide superior sealing, reduced microleakage, and long-term mineralization, decreasing reinfection risk[28].

Management of Root Resorption

Bioaggregate and calcium silicate materials have shown success in arresting internal and external resorption by promoting hard tissue repair[29].

Discussion

Biomimetic restorative dentistry represents a paradigm shift from the traditional concept of inert mechanical replacement toward biologically driven tissue preservation and regeneration.

The fundamental objective of biomimetic materials is to replicate the structural, mechanical, and biological behavior of the dentin pulp complex, thereby promoting long-term functional integration rather than mere defect replacement. The findings discussed in the present context reinforce the growing body of evidence supporting the clinical superiority of biomimetic materials over conventional restorative systems in terms of biological compatibility, sealing ability, and regenerative potential[30,31,32].

One of the most significant advantages of biomimetic materials is their enhanced biocompatibility and bioactivity. Calcium silicate based materials, bioactive glass, and resin-modified bioactive systems release biologically relevant ions such as calcium, phosphate, and hydroxyl ions, which stimulate odontoblastic differentiation and tertiary dentin formation[33,34]. This ion release not only facilitates dentin remineralization but also creates an alkaline environment unfavorable to bacterial survival, thereby contributing to their antimicrobial efficacy[35]. In contrast, conventional restorative materials lack such biological interaction and primarily rely on mechanical retention, which may compromise pulpal health in deep carious lesions.

Sealing ability is another critical determinant of clinical success, particularly in deep restorations where bacterial microleakage can lead to pulpal inflammation and restoration failure. Biomimetic materials exhibit superior marginal adaptation due to their chemical bonding with dentin and low solubility over time[36]. The formation of a hydroxyapatite-like interfacial layer at the material dentin interface enhances micromechanical retention and minimizes gap formation, thereby reducing postoperative sensitivity and secondary caries[37]. These properties address one of the major shortcomings of traditional materials, which often exhibit polymerization shrinkage and interfacial degradation.

From a regenerative perspective, biomimetic materials actively participate in tissue healing rather than merely serving as passive barriers. Their ability to stimulate reparative dentinogenesis and maintain pulp vitality is particularly relevant in minimally invasive dentistry and vital pulp therapy procedures[38]. The biological sealing achieved by these materials supports the concept of restorative regeneration, aligning with contemporary conservative treatment philosophies that prioritize preservation of tooth structure and pulp vitality.

Despite these advantages, several limitations continue to hinder the widespread adoption of biomimetic restorative materials. High material costs remain a significant barrier, especially in resource-limited clinical settings[39]. Additionally, handling difficulties, technique sensitivity, and extended setting times associated with certain calcium silicate based materials can affect clinical workflow and operator preference[40]. Retreatment and removal of bioactive materials may also pose challenges due to their strong adhesion to dentin and structural integration, potentially complicating future endodontic or restorative interventions[41].

Furthermore, long-term clinical evidence remains limited for several newer biomimetic materials. While short and medium-term outcomes are promising, robust longitudinal clinical trials are required to validate their durability, wear resistance, and behavior under functional loading over extended periods[42]. Standardization of clinical protocols and improved clinician training are essential to ensure predictable outcomes and reduce technique-related variability[43].

Future advancements in biomimetic restorative dentistry should focus on optimizing material properties to balance bioactivity with improved handling characteristics and reduced setting times. The integration of nanotechnology, smart materials, and controlled ion-release systems holds promise for enhancing regenerative outcomes while maintaining clinical practicality[44]. As material science continues to evolve, biomimetic restorations are expected to play an increasingly central role in restorative and conservative dentistry, bridging the gap between biological healing and mechanical rehabilitation.

Future Directions

Future biomimetic materials are expected to incorporate smart properties, such as pH-responsive ion release, antimicrobial drug delivery, and regenerative signaling[45]. Nanotechnology and advanced manufacturing techniques will further enhance mechanical strength, bioactivity, and clinical predictability.

Conclusion

Biomimetic approaches in restorative dentistry represent a transformative evolution toward biologically integrated and minimally invasive dental care. Materials such as MTA, Biodentine, Bioaggregate, bioactive glass, and bioceramic sealers enable predictable healing, tissue preservation, and long-term success. Despite existing challenges, biomimetic materials are rapidly redefining restorative and endodontic practice, with future innovations poised to further enhance patient outcomes.

References

1. Vincent JFV, et al. Biomimetics: its practice and theory. J R Soc Interface. 2006;3:471–482.
2. Schmitt O. Biological information processing using the concept of biomimetics. IEEE Trans Biomed Eng. 1969;16:198–203.
3. Zafar MS. Bioactive restorative materials. Dent Mater J. 2020;39:1–13.
4. Banerjee A, et al. Contemporary operative caries management. Br Dent J. 2017;223:215–222.
5. Magne P. Biomimetic restorative dentistry. Quintessence Dent Technol. 2011;34:161–170.
6. Fischer NG, et al. Biomimetic dental materials. Dent Clin North Am. 2019;63:377–398.
7. Higgins JPT, Green S. Cochrane Handbook for Systematic Reviews. Wiley; 2011.
8. Ingle JI, Bakland LK. Endodontics. 6th ed. BC Decker; 2008.
9. Peters OA. Current challenges in endodontic preparation. J Endod. 2004;30:559–567.
10. Walia HM, et al. An initial investigation of the bending and torsional properties of Nitinol root canal files. J Endod. 1988;14:346–351.
11. Shen Y, et al. Metallurgical characterization of NiTi instruments. J Endod. 2013;39:163–172.
12. Peters OA, et al. Instrument fracture and fatigue. Int Endod J. 2012;45:1003–1015.
13. Torabinejad M, et al. Physical and chemical properties of MTA. J Endod. 1995;21:343–346.
14. Parirokh M, Torabinejad M. Mineral trioxide aggregate. J Endod. 2010;36:16–27.
15. Camilleri J. Hydration mechanisms of MTA. Dent Mater. 2007;23:981–987.
16. Laurent P, et al. Biodentine induces odontoblast differentiation. Dent Mater. 2012;28:790–799.
17. Parinyaprom N, et al. Biodentine vs calcium hydroxide. J Endod. 2018;44:341–348.
18. Park JW, et al. Bioaggregate: properties and applications. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010;109:e20–e27.

19. Hench LL. The story of Bioglass®. J Mater Sci Mater Med. 2006;17:967–978.
20. Jones JR. Bioactive glass applications. Acta Biomater. 2015;23:53–82.
21. Zhang W, et al. BC Sealer properties. J Endod. 2009;35:1478–1482.
22. Silva EJNL, et al. MTA Fillapex solubility. Int Endod J. 2013;46:700–706.
23. Lovato KF, et al. ERRM repair materials. J Endod. 2011;37:1543–1546.
24. Jefferies SR. Ceramir cement properties. Compend Contin Educ Dent. 2014;35:552–556.
25. Aguilar P, Linsuwanont P. Vital pulp therapy. Int Endod J. 2011;44:291–299.
26. Witherspoon DE. Apexification techniques. Dent Clin North Am. 2010;54:313–326.
27. Mente J, et al. Perforation repair outcomes. J Endod. 2014;40:790–797.
28. Koch K, et al. Bioceramic sealers. Dent Today. 2012;31:44–47.
29. Asgary S, et al. Management of root resorption. J Endod. 2014;40:1026–1031.
30. Van Meerbeek B, Yoshihara K, Van Landuyt K, Yoshida Y, Peumans M. From Buonocore's pioneering acid-etch technique to self-adhering restoratives: A status perspective of rapidly advancing dental adhesive technology. J Adhes Dent. 2020;22(1):7–34.
31. Bazos P, Magne P. Bio-emulation: Biomimetically emulating nature utilizing a histo-anatomic approach; structural analysis. Eur J Esthet Dent. 2011;6(1):8–19.
32. Schwendicke F, Frencken JE, Bjørndal L, et al. Managing carious lesions: Consensus recommendations on carious tissue removal. Adv Dent Res. 2016;28(2):58–67.
33. Gandolfi MG, Siboni F, Prati C. Chemical-physical properties of TheraCal, Biodentine and MTA Plus in simulated body fluid. Dent Mater. 2014;30(8):e176–e183.
34. Camilleri J. Classification of hydraulic cements used in dentistry. Front Dent Med. 2020;1:9.
35. Zhang W, Li Z, Peng B. Ex vivo cytotoxicity of a new calcium silicate-based canal filling material. Int Endod J. 2010;43(9):769–774.
36. Atmeh AR, Chong EZ, Richard G, Festy F, Watson TF. Dentin–cement interfacial interaction: Calcium silicates and polyalkenoates. J Dent Res. 2012;91(5):454–459.
37. Sauro S, Pashley DH, Montanari M, et al. Effect of simulated pulpal pressure on dentin permeability and resin–dentin bonding. Dent Mater. 2007;23(6):705–713.
38. Bjørndal L, Reit C, Bruun G, et al. Treatment of deep caries lesions in adults: Randomized clinical trials comparing stepwise vs. direct complete excavation. Clin Oral Investig. 2010;14(5):569–578.
39. Malkondu Ö, Kazanda MK, Kazazo lu E. A review on biodentine, a contemporary dentine replacement and repair material. Biomed Res Int. 2014;2014:160951.
40. Camilleri J, Laurent P, About I. Hydration of Biodentine, Theracal LC, and a prototype tricalcium silicate-based dentin replacement material after pulp capping in entire tooth cultures. J Endod. 2014;40(11):1846–1854.
41. De Rossi A, Silva LAB, Gatón-Hernández P, et al. Comparison of pulp tissue response to Biodentine and calcium hydroxide: A histopathological study. J Endod. 2014;40(11) :1768–1773.
42. Hilton TJ, Ferracane JL, Mancl L. Comparison of CaOH with MTA for direct pulp capping: A PBRN randomized clinical trial. J Dent Res. 2013;92(7 Suppl):16S–22S.
43. Opdam NJM, Van de Sande FH, Bronkhorst E, et al. Longevity of posterior composite restorations: A systematic review and meta-analysis. J Dent Res. 2014;93(10):943–949.
44. Sauro S, Osorio R, Watson TF, Toledano M. Therapeutic effects of novel resin bonding systems containing bioactive fillers on mineral-depleted dentin. Dent Mater. 2012;28(8):e1–e12.
45. Schwendicke F, et al. Smart dental materials. J Dent Res. 2020;99:130–136.

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Heal Talk

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TMJ Disorders and Its Management In Young Adolescents

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Abstract

Temporomandibular joint disorders refer to a cluster of condition characterized by pain in the temporomandibular joint or its surrounding tissue, functional limitations of the mandible, or clicking in the temporomandibular joint during motion. Temporomandibular joint disorders are common and often self-limited in the adult population. The prevalence of temporomandibular disorders was increased from 11% to 60% in children/adolescents over a period of time. Clinical evaluation of temporomandibular disorders includes temporomandibular joint sounds, mandibular range of motion, pain evaluation, occlusal examination. The process of diagnosing temporomandibular disorders involves medical, dental history, clinical examination, radiologic examination, ad psychological testing. Imaging studies to evaluate temporomandibular disorders are OPG, lateral cephalogram, CT, CBCT, MRI. The goal of temporomandibular joint disorders treatment is to improve the patient's quality of life through pain relief and functional recovery.

Introduction

The temporomandibular joint is a complex joint that connects the mandible to the temporal bone of the skull, and it is located on either side of the head, just in front of the ears. They are made up of muscles, ligaments, discs, bones and it is a most complex joint in the body. It allows hinge and sliding movements, this complex combination of movements allows its painless and efficient functions[1]. This joint is essential for a range of functions and it is important because they allow the lower jaw to move and perform a variety of functions including chewing, speaking, yawning and swallowing. The articulating surfaces of the temporomandibular joint are covered by a fibrous connective tissue; this avascular and non-innervated structure has a greater capacity to resist degenerative change and regenerate itself than the hyaline cartilage of other synovial joints. When the temporomandibular joint and mandible is mal-aligned, then these smooth muscle actions are not possible and leads to pain and functional limitations.

The first medical description of temporomandibular disorders was in 1887[2], when Annandale identified mechanical problems with the temporomandibular joint disc, later in 1934[2], Costen published a series of articles that attributed temporomandibular joint pain to dental malocclusions. This led to a shift in focus from disease to symptoms, and dentists became more involved in diagnosis and treatment. Then in 1983, American Dental Association (ADA) coined the term temporomandibular disorders.[2] Nevertheless, not all children and adolescent with temporo mandibular joint disorders seek care[3].

In general, reversible treatment of temporomandibular joint disorders consists of a combination of patient education and self-care regimens, bio-behavioral therapy, physical therapy[4], pharmacotherapy. Where as irreversible treatment of temporomandibular joint disorders, especially surgical treatment, is considered when the condition does not respond to conservative treatment. In recent decades, management of temporomandibular joint disorders in young adolescents involves occlusal appliance therapy and there is some evidence of its benefits.

Anatomy and Development of TMJ

The TMJ is a bilateral synovial ginglymoarthrodial joint connecting mandible to temporal bone, enabling hinge (rotation) and glide (translation) via fibrocartilage covered surfaces.

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Components include: mandibular condyle (head/neck), cranial fossa (eminence, tubercle, postglenoid process), capsule (loose superiorly), biconcave articular disc (anterior/ intermediate/ posterior bands, bilaminar retrodiscal tissue with elastin/ collagen), and ligaments (temporomandibular oblique/horizontal, accessory stylomandibular/sphenomandibular).

(Table 1) Vascular supply from superficial temporal/maxillary arteries; innervation via auriculotemporal/masseteric (V3) for sensory/proprioception.

TMJ is formed from a secondary cartilage that arises ectopically rather than from the primary cartilage. It is transformed into bone except at its proximal ends where it forms an articulation with the temporal bone. In the condyle the growth cartilage is near the surface of the bone just beneath the fibrous articular layer. It quickly undergoes atrophic changes in the absence of function but regains endochondral capability when functional demands are reestablished.

Component	Description	Function
Articular Disc	Fibrocartilage (Type I collagen, GAGs); avascular center	Adapts surfaces; divides cavities
Retrodiscal Tissue	Superior (elastic, innervated); inferior (collagenous)	Posterior traction; pressure regulation
Ligaments	major; accessory	Limits translation/ protrusion

Table 1: components and their function

Development begins in week 7 embryonically (mesenchymal condensation), with condylar chondrification (week 9), cavity formation (weeks 10-11), and endochondral ossification by week 17; postnatal growth via secondary cartilage adapts to function until age 20. Neonates show flat temporal surfaces maturing to avascular fibrocartilage by age 3.

Lubrication of Joint

Since there is a synovial lining to temporomandibular joint, it can be assumed that its lubrication is by synovial fluid as in other joints. Unlike other synovial joints, there is no hyaline cartilage on articulating surfaces which may modify lubricating mechanism.

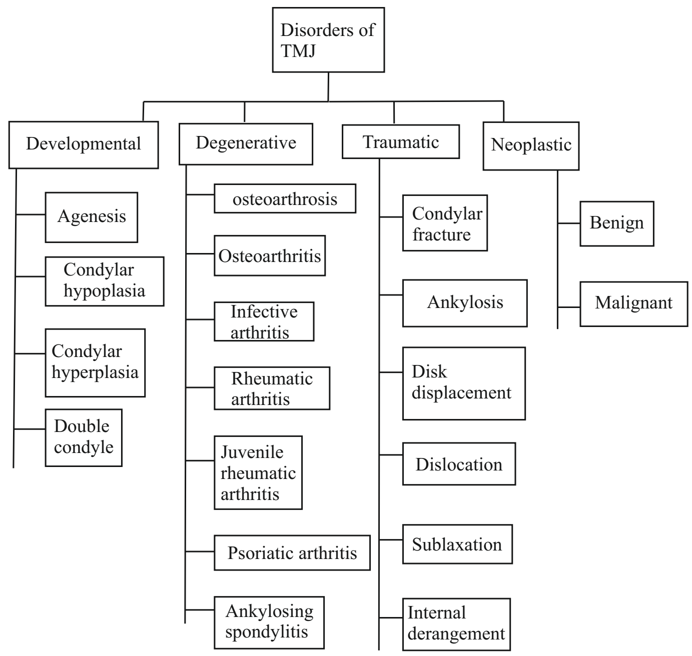
The synovial fluid comes from two sources first from plasma by dialysis and second by secretion from synoviocytes type A and B.

Its volume to be not more than 0.05 ml. However the same author, in 1974, using contrast radiography studies estimated that the upper compartment could accommodate approximately 1.2 ml of fluid without undue pressure being created, while the lower had a capacity of approximately 0.9 ml. The synovial fluid consists of hyaluronic acid and a protein, lubricin.

Previously the former was considered to be the main lubricating factor but recently it was clearly shown that it is primarily lubricin which is the lubricating factor while hyaluronic acid amplifies its boundary lubrication.[5]

Disorders of TMJ

Temporomandibular Disorders refer to a group of conditions affecting the TMJ, the muscles of mastication, and the associated structures that control jaw movement. These disorders are classified based on their origin of occurrence. (Flowchart 1)



Flowchart 1: Disorders of TMJ

Condylar Agenesis

- Rare congenital absence of mandibular condyle (unilateral/ bilateral), disrupting TMJ, jaw, face, dentition.
- Develops from first-trimester blastema disturbances (8th-20th gestational week).

Causes

- Syndromes: Hemifacial microsomia, first branchial arch, mandibulofacial dysostosis (TCOF1 mutations).[6]
- Genetic: TGF- on Meckel's cartilage.[7]
- Developmental: Fetal growth issues (e.g., oculomandibulodyscephaly).[8]

Clinical Features

- Symptoms: Facial asymmetry (39.5%), anterior open bite, altered occlusion, eccentric movements. Signs: Chin deviation/ retrusion, antegonial notch, TMJ.
- pain/ clicking, malocclusion, restricted mouth opening.

Treatment

- Palliative: Multidisciplinary (surgeon, orthodontist); Klamt/modified Klamt appliances for growth stimulation.
- Definitive: Condylar grafts (costochondral), distraction osteogenesis, orthognathic surgery, genioplasty.

Hypoplasia of Condyle

- Underdevelopment of mandibular condyle (unilateral/ bilateral), often from branchial arch issues or growth disturbances.

Causes

- Prenatal (hereditary: achondroplasia, dysostosis; non-hereditary: Pierre Robin, radiation).[9]
- Postnatal (endocrine: hypothyroidism; deficiencies: Vit A; trauma/infection/RA).

Clinical Features

- **Unilateral**: Mandibular elongation/flat face, impacted molars, shift to affected side, malocclusion, ear defects.
- **Bilateral**: Micrognathia, retruded chin, eruption delays, shortened ramus/body.

Treatment

- **Dental (growing patients)**: Bite-jumping (Herbst/Bionator: splints, bars for forward positioning); hybrid appliances (splints, brackets, screws for growth/TMJ relief).
- **Definitive**: Distraction osteogenesis, orthognathic/double jaw surgery, genioplasty, grafts (costochondral), augmentation.

Hyperplasia of Condyle

Rare disorder with excessive unilateral condylar bone growth, causing facial asymmetry.

Causes

Genetic Factors

- Hereditary transmission.
- Mutations in FGFR2, SHOX, or growth hormone receptor genes (e.g., Zhou J et al., 2005; Egyedi P, 1969).[10]

Hormonal Factors

- Imbalances in growth or thyroid hormones.[11]
- Insulin-like growth factors (IGFs) involved (e.g., Gotz W et al., 2007; Pravallika A et al., 2023).[12]

Clinical Features

Unilateral (common in ages 15-19, no sex/side preference):

- Slow TMJ enlargement, progressive mandibular growth.
- Facial asymmetry, chin midline shift, crossbite/open bite on affected side, asymmetric protrusion.

Bilateral

- Anterior crossbite, obtuse mandibular angle, sigmoid notch arc, jaw-tooth disproportion.

Treatment

- Surgical (Definitive)
- Condylectomy or high condylectomy.
- Orthognathic surgery for occlusion/aesthetics.

Orthodontic (Dental)

- Herbst Appliance (fixed, for Class II in growing patients): Telescoping arms, molar anchorage; advances mandible, stimulates condylar growth, controls overjet/overbite.
- Twin Block (removable): Upper/lower acrylic plates with 70° inclined bite blocks and clasps; postures mandible forward, remodels condyle/glenoid fossa, balances jaw growth.

Double Condyle

are mandibular variation with two condylar heads or bifurcation.

Causes

- Congenital/developmental: Persistence of vascularized fibrous septa in condylar cartilage; possible vascular rupture impairing ossification.[13]
- Theories: Blood supply obstruction or trauma (e.g., Borras-ferreres J et al., 2018); retention of fetal connective tissue septa (Ramos F et al., 2006).[14]

Clinical Features

- Usually unilateral, more common in females (3:2 ratio).
- Symptoms: Limited mouth opening, jaw deviation, TMJ pain, clicking/popping, stiffness, locking.
- Signs: Facial asymmetry, jaw deviation on movement, TMJ tenderness, crepitus.

Treatment

- Open Reduction Internal Fixation (ORIF): Align/fix fractured condyles with plates/screws.
- Condylectomy: Remove condyle (e.g., for hyperplasia).
- Orthognathic surgery: Reposition jaws for bite/asymmetry correction.
- TMJ reconstruction: For severe joint damage.

Degenerative Joint Diseases

Osteoarthrosis (osteoarthritis)

Most common joint disease: progressive cartilage degeneration, subchondral bone changes, osteophytes, mild synovitis. TMJ variant non-weight-bearing, fibrous-covered.

Etiopathogenesis

Failed repair of mechanical stress damage; enzymes/cytokines accelerate cartilage breakdown, impair matrix synthesis (Brandt K et al., 2008).[15]

Types

By Depth

- Shallow: Superficial pitting/fraying/scalloping.
- Deep: Substantial soft tissue/bone loss, reduced motion.

By Etiology

- Primary: Age-related wear/tear (>50 years).
- Secondary: Local/systemic factors (younger patients).

Clinical Features

- Dull aching pain (worse on chewing/movement), TMJ tenderness.
- Limited mouth opening, condylar erosion, crepitus.
- Morning stiffness, cold sensitivity; late: chin deviation, bite changes (open bite, overjet), internal derangements.

Treatment

Conservative

- NSAIDs for pain/inflammation.
- Occlusal splints, physical therapy (exercises, heat/cold).
- Jaw rest, intra-articular injections (steroids/hyaluronic acid), acupuncture.

Surgical

- Arthroscopy (arthrocentesis, tissue removal).
- Open surgery (osteophyte removal, cartilage repair).
- TMJ replacement (end-stage).

Infective Prthritis

Rare acute/chronic infection (also called septic arthritis).

Etiology

- Microorganisms (e.g., S. aureus, pneumococci, gonococci) via direct spread (mastoid/ear/cellulitis), hematogenous, or polyarthritis (Hekkenberg R et al., 1999).[16]
- Trauma/infection (dental/parotid); osteomyelitis/ear infection (Al-khalisy H et al., 2015; Kholi R et al., 2005).[17,18]

Types

Acute/chronic infectious, reactive inflammatory, fungal, bacterial, viral.

Prevalence

- 2-10 cases per 100,000 (Morais et al., 2016).[19]

Clinical Features

Acute (unilateral, young children)

- Severe pain, occlusion inability, jaw movement restriction.
- Redness/swelling (fluctuant), exudation/abscess, cartilage digestion, tender cervical nodes.

Chronic/Ankylosis

- Pain, trismus, deviation; fibrous/bony ankylosis, facial asymmetry.
- Unilateral: Asymmetry, chin/mandible deviation, antegonial notch, limited opening, crossbite/Class II.
- Bilateral: "Bird face" deformity, protrusive incisors/open bite, <5mm/nil opening, malocclusion/crowding.

Treatment

Conservative

- Broad-spectrum antibiotics (e.g., ceftriaxone/vancomycin).
- Pain relief, warm compresses, soft diet.

Surgical

- Joint aspiration/drainage; incision for pus/debris removal in severe cases.

Rheumatoid Arthritis

Non-organ-specific autoimmune disease; symmetric small joint involvement (hands/feet); women > men (20-50 years); 20-70% have TMJ issues. ~10% with Sjogren syndrome.

Etiopathogenesis

Two-phase: Initial infection (bacterial/viral, e.g., EBV) auto immune response (rheumatoid factor IgM autoantibody in 85%). Psychosomatic factors; cortisol deficiency; oxidative stress (Jefferies W, 1998; Bennett J, 1978; Piekarska M et al., 2006).[19,20,21]

Associated Syndromes

- Felty's: RA + neutropenia + splenomegaly.
- Caplan's: RA + lung scarring from dust.
- Sjogren's: Dry eyes/mouth.
- Carpal tunnel: Median nerve compression.

Types

- Seropositive (antibodies present).
- Seronegative (no antibodies).
- Juvenile idiopathic arthritis.

Prevalence

0.5-1% adults globally (~18M); F:M 1:2-3; peaks 30-60 years (Venetsanopoulou A et al., 2023).[22]

Clinical Features

General: Bilateral stiffness, crepitus, tenderness/swelling; fever, fatigue, polyarthritis; muscle atrophy, bursitis.

TMJ (Bilateral, Acute/Chronic)

- Acute: Stiffness, pain, tenderness, swelling, limited opening.
- Chronic: Crepitus (most common), deviation, anterior open bite, fibrous ankylosis, referred pain; malocclusion, morning stiffness >30min.
- Children: Micrognathia, growth disturbance, "bird face" (Bache C, 1964; Larheim TA et al., 1981).[23,24]

Treatment

Multidisciplinary, non-curative (preserve function/remission).

- First-line (fast-acting): Aspirin, cortisone (pain/inflammation).
- Second-line DMARDs (slow-acting): Methotrexate, hydroxy chloroquine, leflunomide; biologics (etanercept, infliximab); JAK inhibitors (tofacitinib etc.).

Juvenile Rheumatoid Arthritis

chronic inflammatory arthritis in children (Still's disease); distinct from adult RA; more systemic.

Prevalence

- TMJ involvement: 40-96% (Stoll M et al., 2018)[25]; up to 87% (Fuente A et al., 2016).[26]
- Overall: 70/100,000 children; incidence 8-22.6/100,000; prevalence 7-401/100,000; 1/1,000 worldwide.

Clinical Features

- Peak 1-3 years; bilateral polyarthritis (small/large joints, cervical spine).
- Signs: Splenomegaly, lymphadenopathy, leukocytosis, fever, rash.
- Symptoms: Neck pain, limited motion/opening.
- Complications: Micrognathia (20%+), retrognathia, malocclusion, reduced MIO, pain/dysfunction; growth disturbances, asymmetry (Larheim T et al., 1981).[24]

Treatment

Definitive

- DMARDs (methotrexate, leflunomide, etc.); intra-articular corticosteroids/infliximab.
- Arthrocentesis/lavage; surgery (distraction osteogenesis/ orthognathic) post-maturity.
- Iontophoresis for transdermal corticosteroids.

Dental

- Functional appliances for growth preservation.
- Active splints (ages 8-16, height asymmetry correction).
- Occlusal stabilization splints (pain relief, all ages).

Traumatic Disorders of TMJ

Condylar fracture

Fracture of mandibular condylar process (TMJ component); displaces medially/inferiorly/anteriorly due to lateral pterygoid pull.

Etiology

- Indirect violence/fights (most common; Silvennoinen et al., 1992).[27]
- Parade ground (bilateral from chin blow; protects cranium).
- Falls/RTAs (Badar A et al., 2014)[28]; children: bike/ steps/ sports.

Prevalence

16.5-62% of mandibular fractures (Kozakiewicz M et al., 2023)[29]; higher in males (except child 11-20y); basal > head > low/high neck.

Clinical Features (Unilateral)

Symptoms

- Pain (worse on movement), malocclusion, forward jaw inability, lip paresthesia, midline deviation/fracture side, opening deviation to fracture side.

Signs

- Preauricular swelling/bruising (mastoid ecchymosis), CSF otorrhea, hollow palpation, limited opening/motion, chin shift, shortened ramus, anterior open bite (bilateral).

Diagnosis

- **Inspection**: TMJ swelling, ear bleeding, post-auricular ecchymosis.
- **Palpation**: Tenderness, crepitus, ipsilateral deviation, painful contralateral excursion, molar gagging.

Bilateral Condylar Fractures

Signs as unilateral + jagged molar occlusion, more restricted movements, forward mandibular displacement.

Treatment

Conservative (Closed Reduction)

- Interdental wire fixation (immobilize jaws).
- Intermaxillary fixation (arch bars).
- IMF screws.
- Circum-mandibular wiring.

Surgical (ORIF)

- Open reduction with plates/screws for displacement/ bilateral/failure cases.

Recent Advances

3D Printing

- Patient-specific models/implates/guides for precise planning, custom plates, accurate reduction. (Fig 1)

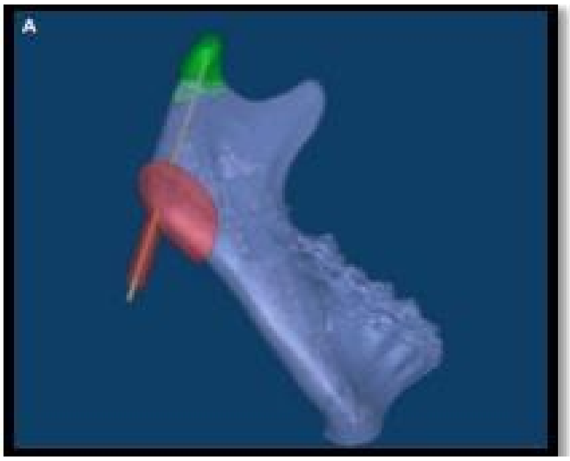


Fig 1 - 3D printing

Kirschner (K-) Wires

- Temporary manipulation/stabilization during ORIF; aids plating. (Fig2)

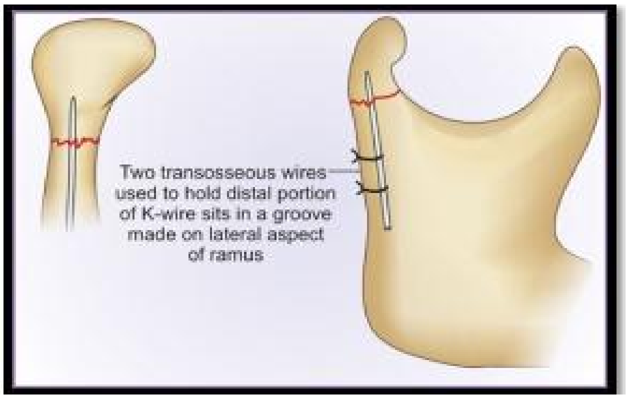


Fig 2 – K wire

Internal Derangement

Abnormal disc-condyle-fossa/eminence relationship; disc often anteromedially displaced/deformed/perforated.

Classification

Condyle-Disc Complex

- Disc displacement.
- Dislocation with/without reduction.

Disk Displacement:

- Anterior with reduction (reciprocal clicks).
- Anterior without reduction.
- Intermittent locking.
- With perforation.

Etiology

Articular remodeling, disc deformation/displacement, steep eminence, elongated ligaments, collagen imbalance, trauma/malocclusion (lateral pterygoid spasm; Wilkes CH et al., 1989).[30]

Prevalence

Up to 25% population (women > men, 30-40y; Warburton G, 2021)[31]; 80% in craniomandibular

Clinical Features (Phases)

- **I (Incoordination):** Catching sensation, no noise/pain.
- **II (w/ Reduction):** Anteromedial slip, opening/closing clicks.
- **III (w/o Reduction):** Further anterior, no condyle pass-over.
- **IV(Adhesion):** Perforation/adhesion to eminence; pain, crepitus, tenderness, limited opening.

Treatment

Conservative

- **Pharmacotherapy:** Analgesics (opioids/non-opioids), NSAIDs/steroids, anxiolytics, antidepressants, muscle relaxants, local anesthetics.
- **Physical Therapy:** Passive (Therabite), active exercises.
- Stress reduction (relaxation/acupuncture).

Occlusal Appliances

- Stabilization (muscle relaxation).
- Anterior repositioning (condyle-disc realign).

Surgical

- Arthrocentesis/lavage (needles, Ringer's flush).
- Arthroscopy (endoscope irrigation).
- Arthrotomy (exposure, disc repositionectomy/graft/ prosthesis).
- Condylotomy (extra-capsular osteotomy).

Recent Advances

- **LLLT:** Reduces pain/clicking (830nm/632+904nm lasers; noninvasive).
- **Tissue Engineering:** TMJ disc constructs (biomechanical matching, shear simulation).

Ankylosis

- Greek for "stiff joint": abnormal immobility/consolidation.

Classification

- True (Intra-articular): Fibrous/bony adhesion of surfaces.
- False (Extra-articular): External pathology limits mobility.
- Bony vs. Fibrous.
- Partial (incomplete) vs. Complete (full union).
- Sawhney (1986): I (minimal fusion/fibrous), II (outer edge fusion), III (mandible-temporal bridge), IV (bone mass replaces joint).

Etiology

False

Myogenic (fibrosis/myositis ossificans), neurogenic (epilepsy/tumor), psychogenic (hysterical trismus), coronoid impingement, neoplasm.

True

- Congenital (birth injury/syphilis).
- Trauma (most common: 80-90%; Garoma G et al., 2022).[32]
- Inflammatory (otitis/osteomyelitis, RA, infections; Gupta et al., 2012).[33]

Prevalence

F > M (1:9); peak 10-15y (70%; Gupta et al., 2012)[33]; trauma 78-90%; unilateral left >; bony 68% (Garoma G et al., 2022).[32]

Pathogenesis

Hemarthrosis calcification/obliteration; fibrous bony fusion; meniscus destruction, fossa/condyle flattening, space narrowing (may extend to cranial base).

Clinical Features

Varies by severity/onset/duration; early (<15y): severe deformity/loss; late (>15y): functional loss.

Unilateral (childhood onset)

- Asymmetry, affected-side chin/mandible deviation/ recession/fullness, antegonial notch, limited opening, crossbite/Class II/posterior crossbite, absent condylar motion.

Bilateral

- Symmetric micrognathia, "bird face"/receding chin, reduced neck-chin angle, bilateral antegonial notch, Class II/protrusive incisors/anterior open bite, narrow maxilla, <5mm/nil opening, poor dentition/malocclusion/impactions.

Treatment (Surgical)

- **Condylectomy** (fibrous; recontour + alloplast).
- **Gap Arthroplasty** (extensive bony; 1cm+ gap via osteotomies).
- **Interpositional Arthroplasty** (gap + autogenous/alloplastic barrier; lowest recurrence).

Dislocation

Condyle forcefully displaced anteriorly (usually) out of fossa but within capsule; beyond eminence.

Classification

First

- Acute (complete luxation).
- Chronic recurrent (habitual) subluxation.
- Long-standing/chronic protracted.

Second

- Anterior (most common), posterior, central, medial/lateral.

Etiology

- **Extrinsic/Iatrogenic** (60%): Trauma (chin blow), GA/mouth gag, extractions.
- **Intrinsic/Self-induced** (40%): Yawning/ vomiting/ singing/ laughing/seizures; lateral pterygoid spasm locks condyle.

Etiopathogenesis

- **Anterior**: Muscle sequence interruption (masseter/temporalis contract before pterygoid relaxes) spasm/trismus.
- **Posterior**: Chin blow mastoid push, EAC injury.
- **Chronic Recurrent**: Hypoplastic eminence/narrow fossa/ laxity/hypermobility/dystonias/drugs.

Prevalence

5.3/100,000 spontaneous anterior; higher in 18-25y, F > M; incidence up to 25/100,000/y, lifetime 5-8% (Neff A et al., 2021)[34].

Clinical Features

Unilateral Acute

- Mastication/swallowing/speech difficulty, drooling, contra lateral chin deviation/crossbite/open bite.
- Partly open mouth, non-palpable condyle, pre-tragus depression.

Bilateral Acute

- Pain, inability to close, tense muscles, forward mandible, molar gagging/anterior open bite, temporal pain, preauricular hollowness.

Treatment

Conservative (Reduction)

- **Wrist-pivot** (counterclockwise thumbs/fingers; Fig 3).

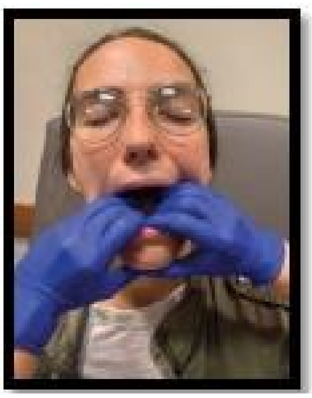


Fig 3 – Wrist-pivot technique

- **Hippocratic** (thumbs on teeth, down/back pressure; Fig 4).

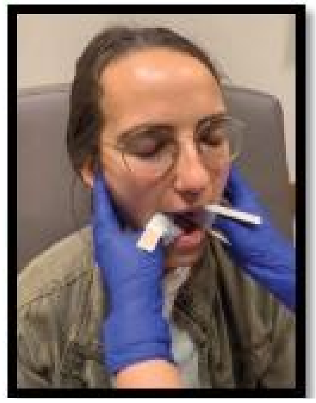


Fig 4 - Hippocratic reduction method

- **Extraoral** (external pressure; Fig 5).

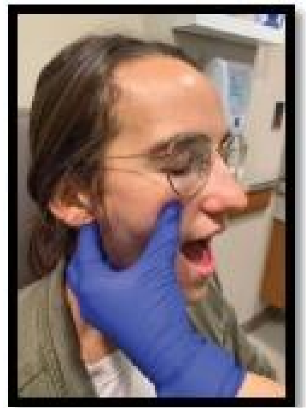


Fig 5 - Extraoral method

Syringe (bite/roll between molars; Fig 6).

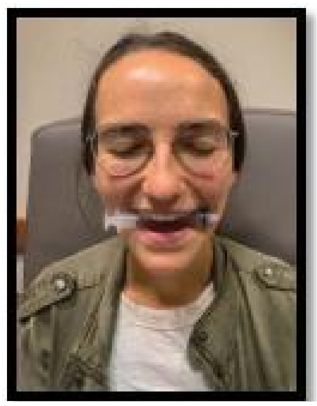


Fig 6 - Syringe technique

Surgical

- Gap arthroplasty (superior/protracted).
- Condylectomy (prolonged lateral).
- ORIF + IMF (fractures).
- Meniscoplasty/ectomy, total joint replacement (chronic/ degenerative).

Subluxation (Hypermobility)

Recurrent, incomplete, self-reducing anterior condyle excursion beyond eminence; due to ligament/capsule laxity, eminential erosion/flattening, trauma.

Etiology

- Wide mouth opening (dental/singing/yawning/sleep).
- Surgical procedures/GA (ligament stretch/rupture).
- OA/condylar degeneration.
- Psychiatric/minor trauma.

Prevalence

25-50% population; middle-aged females (Han I et al., 2014).[35]

Clinical Features

- Unilateral/bilateral; pain/discomfort during max opening.
- Clicking/jumping condyle (palpable/sliding over eminence).
- Transient lock on wide opening, inability to close, salivation, muscle spasm/TMJ pain.

Treatment

Conservative

- Pain relief (ibuprofen).
- Exercises: Goldfish (partial/full opening), chin tuck, Rocabado's 6x6, stretches/strengthening.
- Mouthguard/splint.
- Botulinum toxin/sclerosing injections.

Surgical

- Arthrocentesis (drainage).
- Capsular plication (tighten laxity).
- Disc removal/repositioning.

Functional Disorders

- Myofascial pain - dysfunction syndrome:
- Chronic muscle/fascia inflammation; spasm-induced pain from trigger points (TrPs) causing referred pain.

Etiology

- Emotional stress, sleep issues, habits/posture/strains.
- Systemic: Nutrition/fatigue/viruses.
- Occlusal friction/ischemia hyperfunction/fatigue (Gozler S et al., 2017).[36]

Prevalence

30-93% musculoskeletal pain patients; 30-85% general population; F:M 3:1; ages 27-50 (Dua A et al., 2025).[37]

Clinical Features

Laskin's Signs

- Unilateral dull ache (ear/preauricular/angle; worse daytime).
- Muscle tenderness (mandible neck/max tuberosity).
- TMJ click/pop.
- Limited opening/mandible deviation.

Symptoms

Aching/throbbing, tender knots, sleep issues, malaise/fatigue.

Signs

TMJ pain/click/restriction, midline deviation, restricted contralateral laterotrusion.

Treatment

Muscle

- Non-invasive: Massage/acupressure/ultrasound, heat/ice/Fluori-Methane, TENS (C-TENS/AL-TENS), spray/stretch.
- Invasive: TrP injections (anesthetic/saline/steroid), dry needling/acupuncture, EG stimulation.

Intraoral Appliances

- Soft bite guard (night/habit breaker).
- Anterior bite plane/Lucia jig (short-term).
- Stabilisation splint (occlusion/neuromuscular).
- Gnathological splint (centric discrepancies).

Recent Advances

- **Botulinum Toxin injection:** It enhances vascularity by augmenting the blood flow to the affected muscles and releases the taut muscle fibres caused by abnormally contracting muscles.
- **LLLT (cold laser therapy or low-level laser therapy):** It plays a substantial role in the treatment of generalised musculo - fascial disorders and facial pain relief.

Conclusion

Through this study, the multifactorial etiology, clinical features, and management strategies of TMDs in adolescents have been explored. A consistent theme is the importance of early recognition and intervention. When properly identified and managed, most temporomandibular disorders in this age group respond well to conservative, non-invasive treatments ranging from patient education and behavior modification to physical therapy and orthodontic support. In rare cases where structural anomalies or persistent dysfunction are present, interdisciplinary approaches involving dental, orthopedic, and psychological care become essential.

Reference

1. Buescher JJ. Temporomandibular joint disorders. American family physician. 2007 Nov 15;76(10):1477-82.
2. Laskin DM. Etiology of the" pain-dysfunction" syndrome. Information dentaire. 1977 May 1;59(20):21-32.
3. Mélou C, Sixou JL, Sinquin C, Chauvel-Lebret D. Temporomandibular disorders in children and adolescents: A review. Archives de Pédiatrie. 2023 Jul 1;30(5):335-42.
4. Gharavi SM, Qiao Y, Faghihimehr A, Vossen J. Imaging of the temporomandibular joint. Diagnostics. 2022 Apr 16;12(4):1006.
5. Jay GD. Characterization of a bovine synovial fluid lubricating factor. I. Chemical, surface activity and lubricating properties. Connective tissue research. 1992 Jan 1;28(1-2):71-88.
6. Gorlin RJ. Developmental anomalies of the face and oral structures. THOMA'S Oral Pathology Volume One. 1970;(3):21-96.
7. Ito Y, Bringas Jr P, Mogharei A, Zhao J, Deng C, Chai Y. Receptor regulated and inhibitory Smads are critical in regulating transforming growth factor –mediated Meckel's cartilage development. Developmental Dynamics: An Official Publication of the American Association of Anatomists. 2002 May;224(1):69-78.
8. Nicholson AD, Menon S. Hallerman-Streiff syndrome. Journal of Postgraduate Medicine. 1995 Jan 1;41(1):22-3.
9. Habib H, Hatta T, Udagawa J, Zhang L, Yoshimura Y, Otani H. Fetal jaw movement affects condylar cartilage development. Journal of dental research. 2005 May;84(5):474-9.
10. Zhou J, Lu Y, Gao XH, Chen YC, Lu JJ, Bai YX, Shen Y, Wang BK. The growth hormone receptor gene is associated with mandibular height in a Chinese population. Journal of dental research. 2005 Nov;84(11):1052-6.
11. Egyedi P. Aetiology of condylar hyperplasia. Australian Dental Journal. 1969 Feb;14(1):12-23.
12. Pravallika A, Menon S, Sham ME, Archana S, Mathews S. Condylar Hyperplasia: Case Report and Literature Review. Journal of Maxillofacial and Oral Surgery. 2023 Dec;22(4):916-26.
13. Götz W, Lehmann TS, Appel TR, Rath-Deschner B, Dettmeyer R, Luder HU, Reich RH, Jäger A. Distribution of insulin-like growth factors in condylar hyperplasia. Annals of Anatomy-Anatomischer Anzeiger. 2007 Jul 11;189(4):347-9.
14. de Moraes Ramos FM, de Vasconcelos Filho JO, Manzi FR, Bóscolo FN, de Almeida SM. Bifid mandibular condyle: a case report. Journal of oral science. 2006;48(1):35-7.
15. Borrás-Ferreres J, Sánchez-Torres A, Gay-Escoda C. Bifid mandibular condyles: A systematic review. Medicina Oral, Patología Oral y Cirugía Bucal. 2018 Nov 21;23(6):672.
16. Brandt KD, Dieppe P, Radin EL. Etiopathogenesis of osteoarthritis. Rheumatic Disease Clinics of North America. 2008 Aug 1;34(3):531-59.
17. Hekkenberg RJ, Piedade L, Mock D, Baker G, Freeman JL. Septic arthritis of the temporomandibular joint. Otolaryngology—Head and Neck Surgery. 1999 May;120(5):780-2.
18. Al-Khalisy HM, Nikiforov I, Mansoora Q, Goldman J, Cheriyath P. Septic arthritis in the temporomandibular joint. North American Journal of Medical Sciences. 2015 Oct;7(10):480.

19. Kohli R, Hadley S. Fungal arthritis and osteomyelitis. Infectious Disease Clinics. 2005 Dec 1;19(4):831-51.
20. Morais HH, Peixoto TS, Barbalho JC, Dias TG, Vasconcellos RJ, Lucena EE. Septic arthritis of the TMJ: a case report. RGO-Revista Gaúcha de Odontologia. 2016 Apr;64(7):193-7.
21. Jefferies WM. The etiology of rheumatoid arthritis. Medical hypotheses. 1998 Aug 1;51(2):111-4.
22. Bennett JC. The infectious etiology of rheumatoid arthritis. Arthritis & Rheumatism: Official Journal of the American College of Rheumatology. 1978 Jun;21(5):531-8.
23. Matyska-Piekarska E, Łuszczewski A, Łacki J, Wawer I. The role of oxidative stress in the etiopathogenesis of rheumatoid arthritis. Postepy Higieny i Medycyny Doswiadczalnej (Online). 2006 Jan 1;60(3):617-23.
24. Venetsanopoulou AI, Alamanos Y, Voulgari PV, Drosos AA. Epidemiology and risk factors for rheumatoid arthritis development. Mediterranean Journal of Rheumatology. 2023Dec 30;34(4):404.
25. Bache C. Mandibular growth and dental occlusion in juvenile rheumatoid arthritis. Acta Rheumatologica Scandinavica. 1964 Dec 1;10(1-4):142-53.
26. Larheim TA, Haanaes H. Micrognathia, temporomandibular joint changes and dental occlusion in juvenile rheumatoid arthritis of adolescents and adults. European Journal of Oral Sciences. 1981 Aug;89(4):329-38.
27. Stoll ML, Kau CH, Waite PD, Cron RQ. Temporomandibular joint arthritis in juvenile idiopathic arthritis, now what?. Pediatric Rheumatology. 2018 Dec;6(3)16:1-4.
28. de la Fuente SE, Angenete O, Jellestad S, Tzaribachev N, Koos B, Rosendahl K. Juvenile idiopathic arthritis and the temporomandibular joint: a comprehensive review. Journal of Cranio-Maxillofacial Surgery. 2016 May 1;44(5):597-607.
29. Silvennoinen U, Iizuka T, Lindqvist C, Oikarinen K. Different patterns of condylar fractures: an analysis of 382 patients in a 3-year period. Journal of oral and maxillofacial surgery. 1992 Oct 1;50(10):1032-7.
30. Arshad Badar Mu, Ali Shah Sa, Wahid A. Etiology of Mandibular Condylar Fractures; A Study from Tertiary Care Hospital of Lahore. Pakistan Oral & Dental Journal. 2014 Jan 1;34(1):34-52.
31. Kozakiewicz M, Pruszyńska P. Lateral Pterygoid Muscle Alteration in Patients Treated Surgically Due to Mandibular Head Fractures. Journal of Clinical Medicine. 2023 Jul 20;12(14):4789.
32. Wilkes CH. Internal derangements of the temporomandibular joint: pathological variations. Archives of otolaryngology–head & neck surgery. 1989 Apr 1;115(4):469-77.
33. Warburton G. Internal derangements of the temporomandibular joint. InOral and maxillofacial surgery for the clinician 2021 Feb 15;(4):1361-1380.
34. Garoma G, Dejene D, Uma G. Temporomandibular joint ankylosis; aetiology, pattern and treatment. J Dent Health Oral Disord Ther. 2022;13(2):33-7.
35. Gupta VK, Mehrotra D, Malhotra S, Kumar S, Agarwal GG, Pal US. An epidemiological study of temporomandibular joint ankylosis. National journal of maxillofacial surgery. 2012 Jan 1;3(1):25-30.
36. Neff A, McLeod N, Spijkervet F, Riechmann M, Vieth U, Kolk A, Sidebottom AJ, Bonte B, Speculand B, Saridin C, Wilms CT. The ESTMJS (European Society of Temporomandibular Joint Surgeons) consensus and evidence-based recommendations on management of condylar dislocation. Journal of clinical medicine. 2021 Oct 29;10(21):5054-5068.
37. Han I, Kim TK, Yoo JH, Park JH, Chung EY. Dislocation of the temporomandibular joint following general anesthesia. Korean Journal of Anesthesiology. 2014 Dec 30;(4):67-113.
38. Gözler S. Myofascial pain dysfunction syndrome: Etiology, diagnosis, and treatment. Temporomandibular joint pathology-current approaches and understanding, Y. Emes, B. Aybar, G. Dergin (eds.). Intech Open, Istanbul, Turkey. 2018 Feb 28;(5):17-45.
39. Dua A, Chang KV. Myofascial pain syndrome. InStatPearls [Internet] 2025 Apr 13. (1):21-36.

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Heal Talk

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Developmental Milestones in Children: A Comprehensive Review

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Abstract

Early childhood development is a dynamic and multifactorial process encompassing physical growth, neuro development, cognition, language acquisition, and socio-emotional maturation. Developmental milestones serve as structured indicators of a child's functional progress and provide an essential framework for early identification of developmental delays. In pediatric dentistry, understanding these milestones is critical for delivering age-appropriate, behaviorally informed, and preventive oral healthcare. This review article synthesizes contemporary evidence on child developmental milestones, screening tools, reflex integration, and influencing biological, environmental, and psychosocial factors. Emphasis is placed on the relevance of developmental surveillance to pediatric dental practice, highlighting the role of dentists in early identification, parental counseling, and interdisciplinary referral.

Keywords: Child development, developmental milestones, pediatric dentistry, developmental screening, early intervention.

Introduction

Infancy and early childhood represent critical periods of rapid growth and neuro development, laying the foundation for lifelong learning, behavior, and health. Child development refers to the progressive acquisition of physical, cognitive, language, and socio emotional skills that occur in a predictable yet individually variable sequence. Developmental milestones are functional skills or behaviors that most children achieve within a specific age range and are widely used as benchmarks to monitor normal development.

Globally, a significant proportion of children particularly in low and middle-income countries experience developmental delays, often due to preventable biological and environmental factors. Early identification through milestone monitoring enables timely intervention, which has been shown to improve cognitive, social, and adaptive outcomes. In pediatric dentistry, knowledge of developmental milestones is indispensable, as oral health care is closely linked with feeding practices, speech development, behavior management, and psychosocial maturation. This review aims to provide a comprehensive and clinically relevant overview of developmental milestones, their assessment, and their implications for pediatric dental practice.

Methodology of Literature Review

A narrative review methodology was adopted. Peer-reviewed articles, cohort studies, cross-sectional studies, randomized controlled trials, and systematic reviews related to child developmental milestones were analyzed. The literature spans classical developmental theories to contemporary population-based studies, with emphasis on motor, cognitive, language, and socio emotional development, as well as standardized developmental screening tools. Special consideration was given to studies relevant to clinical practice and early intervention.

Concept and Definitions

Growth and Development

Growth refers to quantitative increases in body size or physical dimensions resulting from cellular proliferation and protein synthesis. In contrast, development denotes qualitative changes in functional abilities and skills, including motor coordination, language, cognition, and social interaction. While growth can be measured objectively, development reflects the maturation and integration of complex biological and environmental processes.

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Developmental Milestones

Developmental milestones are age-specific functional achievements that reflect a child's progress across major developmental domains. Although the sequence of milestone acquisition is generally predictable, the timing may vary among individuals due to genetic, environmental, cultural, and socioeconomic influences.

Historical Perspective of Developmental Milestones

The scientific understanding of child development has evolved over more than a century. Early pioneers such as G. Stanley Hall emphasized normative developmental patterns, while Arnold Gesell introduced the concept of biological maturation and standardized developmental schedules. Jean Piaget's cognitive developmental theory highlighted the child as an active constructor of knowledge, whereas Erik Erikson integrated psychosocial dimensions into developmental staging. Advances in neuroscience and early intervention research have further underscored the plasticity of the developing brain and the importance of early experiences. Contemporary approaches recognize the interaction between biological maturation and environmental stimulation, supporting individualized yet structured developmental surveillance.

Domains of Child Development

Motor Development

Motor development encompasses gross and fine motor skills and follows cephalocaudal (head-to-toe) and proximodistal (center-to-periphery) patterns. Gross motor skills involve large muscle groups and include head control, sitting, standing, walking, and running. Fine motor skills involve precise hand and finger movements, such as grasping, pincer grip, drawing, and writing. Delays in motor milestones may indicate neurological disorders, nutritional deficiencies, or environmental deprivation.

Age	Red Flag
4 months	Lack of steady head control while sitting
9 months	Inability to sit
18 months	Inability to walk independently

Table.1: Motor Red Flags

Fig.1: Fine Motor & Gross Motor Development Activities

Reflex Integration

Primitive reflexes are involuntary motor responses present at birth that facilitate survival and early movement. These reflexes typically integrate as higher cortical control develops. Persistence or absence of reflexes beyond expected ages may signal neurological impairment. Understanding reflex integration assists clinicians in identifying atypical motor development during infancy.

Reflex	Appears At	Disappears By
Rooting	Birth	4 months
Sucking	Birth	4 months
Moro	Birth	5 – 6 months
Palmar Grasp	Birth	5 – 6 months
Plantar Grasp	Birth	9 – 12 months
Babinski	Birth	12 – 24 months
Tonic Neck	1 month	4 – 5 months
Stepping	Birth	2 months
Galant	Birth	4 – 6 months

Table.2: Types & duration of Reflexes

Fig.2: Reflexes visual representation

Cognitive Development

Cognitive development refers to the maturation of mental processes such as attention, memory, reasoning, and problem-solving. Piaget's stages from sensorimotor to formal operational provide a framework for understanding age-related cognitive abilities. Cognitive milestones are influenced by genetics, nutrition, stimulation, education, and emotional security. Delays may manifest as learning difficulties or impaired adaptive functioning.

Age Group	Key Cognitive Milestones
Infants (0 – 2 yrs)	Recognize caregivers, imitate facial expressions, begin to use objects purposefully
Toddlers (2 – 3 yrs)	Use simple sentences, sort objects by shape/color, follow simple instructions
Preschoolers (3 – 5 yrs)	Ask many questions, engage in imaginative play, understand time concepts
School-age (6 – 12 yrs)	Logical thinking, improved memory, ability to understand others view points
Adolescents (13 – 18 yrs)	Abstract thinking, hypothesis testing, future planning, moral reasoning

Table.3: Cognitive Milestones duration Chart

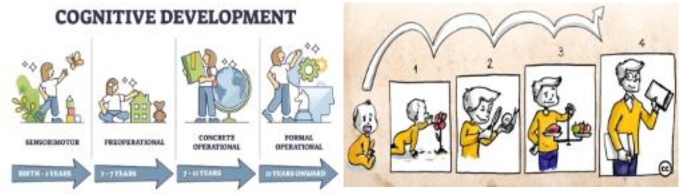

Fig.3: Visual representation of Cognitive development

Language and Communication Development

Language development includes receptive and expressive abilities and progresses rapidly during the first five years of life. Early vocalizations, babbling, first words, and sentence formation are critical milestones. Language delays can affect social interaction, academic readiness, and behavior, making early identification and intervention essential.

Fig.4: Language Pyramid

Fig.5: Language skills representation

Social and Emotional Development

Socio-emotional development involves the ability to form relationships, regulate emotions, and engage in social interactions. Attachment to caregivers, peer relationships, and cultural context play significant roles. Emotional development evolves from external regulation by caregivers to internal self-regulation during later childhood.

Developmental Screening Tools

Several standardized tools are available to monitor developmental progress:

- Denver Developmental Screening Test (DDST): Assesses gross motor, fine motor-adaptive, language, and personal-social domains.
- Ages and Stages Questionnaires (ASQ): Parent-completed screening tool covering multiple developmental areas.
- Bayley Scales of Infant and Toddler Development (BSID): Comprehensive assessment of cognitive, language, motor, social-emotional, and adaptive behavior.
- Peabody Developmental Motor Scales (PDMS): Detailed evaluation of gross and fine motor skills.

These tools aid in early detection of delays and guide referral for diagnostic evaluation and intervention.

Factors Influencing Developmental Milestones

Developmental outcomes are shaped by a complex interplay of factors including genetics, nutrition, health status, caregiver interaction, socioeconomic conditions, cultural practices, and psychosocial stimulation. Maternal education, mental health, and parenting practices significantly influence early development. Environmental enrichment and early intervention programs have demonstrated substantial benefits in mitigating developmental risks.

Relevance to Pediatric Dentistry

Pediatric dentists frequently encounter children during critical developmental periods. Knowledge of developmental milestones assists in:

- Anticipating age-appropriate behavior and communication abilities.
- Tailoring behavior management techniques.
- Identifying feeding and speech-related concerns.
- Recognizing signs of developmental delay and initiating timely referrals.

Oral health professionals thus play an important role within the multidisciplinary team supporting child development.

Discussion

The literature consistently demonstrates that early developmental progress is associated with improved cognitive, educational, and social outcomes later in life. While milestone timing varies, significant deviations from expected patterns warrant further evaluation. Developmental surveillance should be continuous, culturally sensitive, and integrated into routine healthcare encounters, including dental visits.

Conclusion

Developmental milestones provide a valuable framework for monitoring child growth and functional maturation. Early identification of deviations enables timely intervention, optimizing long-term outcomes. For pediatric dentists, integrating developmental knowledge into clinical practice enhances comprehensive child-centered care. Ongoing education of parents and collaboration with pediatric healthcare providers are essential to promote optimal development and oral health.

References

1. Alhajri RA, Al-Harbi MN, Alanazi AM, Alanazi AM, Al-Harbi AN. Assessment of awareness and knowledge of parents about child developmental milestones in Al-Kharj City, Saudi Arabia. Medical Science. 2023;27:e189ms2994.
2. Joshi NH, Trivedi AV, Mihir Rupani MR. Cross-sectional study on assessment of the knowledge of mothers regarding identification of developmental milestones of young children at an urban area of Bhavnagar, Gujarat.
3. Gupta A, Kalaivani M, Gupta SK, Rai SK, Nongkynrih B. The study on achievement of motor milestones and associated factors among children in rural North India. Journal of family medicine and primary care. 2016 Apr 1;5(2):378-82.
4. Murray GK, Jones PB, Kuh D, Richards M. Infant developmental milestones and subsequent cognitive function. Annals of neurology. 2007 Aug;62(2):128-36.
5. Alghamdi HM, Altirkistani BA, Baatya RA, Marghalani YO, Alshaikh NM, Baatya R, Alshaikh N. Bridging the gap: parents' knowledge of childhood developmental milestones and the early identification of children with developmental delay. Cureus. 2023 Nov 3;15(11).
6. Gerber RJ, Wilks T, Erdie-Lalena C. Developmental mile stones: motor development. Pediatrics in review. 2010 Jul 1;31(7):267-77.
7. Ejemen OP, Owumi B, Oluwafemi DI. Socio-cultural context of developmental milestones in infancy in south west Nigeria: A qualitative study. European Scientific Journal. 2015 Jun 1;11(17).
8. Tamis LeMonda CS, Bornstein MH, Baumwell L. Maternal responsiveness and children's achievement of language milestones. Child development. 2001 May;72(3):748-67.
9. Taanila A, Murray GK, Jokelainen J, Isohanni M, Rantakallio P. Infant developmental milestones: a 31-year follow-up. Developmental medicine and child neurology. 2005 Sep;47 (9):581-6.
10. Luinge MR, Post WJ, Wit HP, Goorhuis-Brouwer SM. The ordering of milestones in language development for children from 1 to 6 years of age. Journal of Speech, Language, and Hearing Research. 2006;49(5):923-40.
11. Holodynski M. Milestones and mechanisms of emotional development. InEmotions as bio-cultural processes 2008 Sep 15 (pp. 139-163). New York, NY: Springer US.
12. Avan BI, Kirkwood B. Role of neighbourhoods in child growth and development: does 'place'matter?. Social science & medicine. 2010 Jul 1;71(1):102-9.
13. Rikhy S, Tough S, Trute B, Benzies K, Kehler H, Johnston DW. Gauging knowledge of developmental milestones among Albertan adults: a cross-sectional survey. BMC public health. 2010 Apr 8;10(1):183.
14. Nikolaeva E, Merenkova V. The effect of a mother's level of attachment and her emotional intelligence on a child's health during its first year of life. Psychology. 2013 May 16;4 (5):483-7.
15. Guevara JP, Gerdes M, Localio R, Huang YV, Pinto-Martin J, Minkovitz CS, Hsu D, Kyriakou L, Baglivo S, Kavanagh J, Pati S. Effectiveness of developmental screening in an urban setting. Pediatrics. 2013 Jan 1;131(1):30-7.
16. Ghassabian A, Sundaram R, Bell E, Bello SC, Kus C, Yeung E. Gross motor milestones and subsequent development. Pediatrics. 2016 Jul 1;138(1):e20154372.
17. Safadi RR, Ahmad M, Nassar OS, Alashhab SA, AbdelKader R, Amre HM. J ordanian mothers' knowledge of infants' childrearing and developmental milestones. International Nursing Review. 2016 Mar;63(1):50-9.
18. Larson LM, Young MF, Ramakrishnan U, Girard AW, Verma P, Chaudhuri I, Srikantiah S, Martorell R. A cross-sectional survey in rural Bihar, India, indicates that nutritional status, diet, and stimulation are associated with motor and mental development in young children. The Journal of nutrition. 2017 Aug 1;147(8):1578-85.
19. Alkhazrajy LA, Aldeen ER. Assessment of mothers knowledge regarding the developmental milestone among children under two years in Iraq. Am J Appl Sci. 2017 Sep 1;14(9):869-77.
20. Ahun MN, Aboud FE, Aryeetey R, Colecraft E, Marquis GS. Child development in rural Ghana: Associations between cognitive/language milestones and indicators of nutrition and stimulation of children under two years of age. Canadian Journal of Public Health. 2017 Sep;108(5):e578-85.
21. d'Entremont L, Gregor M, Kirou E, Nelligan L, Dennis D. Developmental milestones for productivity occupations in children and youth: An integrative review. Work. 2017 Feb 6;56(1):75-89.
22. Ertem IO, Krishnamurthy V, Mulaudzi MC, Sguassero Y, Balta H, Gulumser O, Bilik B, Srinivasan R, Johnson B, Gan G, Calvocoressi L. Similarities and differences in child development from birth to age 3 years by sex and across four countries: a cross-sectional, observational study. The Lancet Global Health. 2018 Mar 1;6(3):e279-91.
23. Souza MA, Damasceno SS, Cruz RD, Viana MC, Silva AV, Oliveira DR. Construção e validação de tecnologia comportamental para acompanhamento dos marcos do desenvolvimento infantil.
24. Tuovinen S, Lahti Pulkkinen M, Girchenko P, Lipsanen J, Lahti J, Heinonen K, Reynolds RM, Hämäläinen E, Kajantie E, Laivuori H, Pesonen AK. Maternal depressive symptoms during and after pregnancy and child developmental milestones. Depression and anxiety. 2018 Aug;35(8):732-41.
25. Ertem IO, Krishnamurthy V, Mulaudzi MC, Sguassero Y, Balta H, Gulumser O, Bilik B, Srinivasan R, Johnson B, Gan G, Calvocoressi L. Similarities and differences in child development from birth to age 3 years by sex and across four countries: a cross-sectional, observational study. The Lancet Global Health. 2018 Mar 1;6(3):e279-91.
26. Sheldrick RC, Schlichting LE, Berger B, Clyne A, Ni P, Perrin EC, Vivier PM. Establishing new norms for developmental milestones. Pediatrics. 2019 Dec 1;144(6):e20190374.
27. Karuppannan A, Ramamoorthy T, Rammamoorthi A, Ravichandran L. Mother's knowledge on child's developmental milestones and parenting skills in Int J Health Sci Res. 2020;10(2):242-7.
28. Darsoni, Dr Shehri, Dr PY - 2020/10/01 SP - 09 EP - 14 T1 Milestones: Are mothers aware? VL-3 DO-10.33545/ comed. 2020.v3.i4a.169 JO-International Journal of Advanced Community Medicine
29. Alexandre DD, Alpes MF, Reis AC, Mandrá PP. Validation of a booklet on language developmental milestones in childhood. Revista CEFAC. 2020 May 8;22(2):e16219.
30. Solís-Cordero K, Palombo CN, Duarte LS, Munhoz RI, Toriyama AT, Borges AL, Fujimori E. Developmental surveillance in primary health care: absence of child development milestones and associated factors. Revista Brasileira de Saúde Materno Infantil. 2020;20(4):925-34.
31. Visser-Bochane MI, Reijneveld SA, Krijnen WP, Van der Schans CP, Luinge MR. Identifying milestones in language development for young children ages 1 to 6 years. Academic pediatrics. 2020 Apr 1;20(3):421-9.
32. Hannigan LJ, Askeland RB, Ask H, Tesli M, Corfield E, Ayorech Z, Magnus P, Njølstad PR, Øyen AS, Stoltenberg C, Andreassen OA. Developmental milestones in early childhood and genetic liability to neurodevelopmental disorders. Psychological Medicine. 2023 Apr;53(5):1750-8.
33. Soni DJ, Srinivasan DA. A study of primigravida mothers in rural Karad taluka, Maharashtra, acknowledging the child's developmental milestones. Journal of Ecophysiology and Occupational Health. 2021 Jun;21(2):52-5.

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Open Access Full Text Article

Contemporary Obturation: Materials, Techniques and Biological Perspectives

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Abstract

The success of modern endodontic therapy relies heavily on the ability to thoroughly clean, shape, disinfect, and obturate the root canal space. Among these, obturation has undergone the most significant evolution over the past few decades. "Contemporary obturation" reflects a paradigm shift from traditional gutta-percha based cold lateral condensation to advanced materials, improved sealer chemistry, bioceramics, hydraulics, warm vertical compaction, carrier based technologies, and injectable obturation systems. This article provides a comprehensive review of present day obturation philosophies, materials, and techniques. It integrates current evidence on the biological rationale for three dimensional obturation, the limitations of legacy methods, advancements in gutta-percha formulations, bioactive sealers, and the trend toward single cone hydraulics supported by minimally invasive endodontics (MIE). Emerging materials such as bioceramic coated cones, resin sealers, injectable bioceramic pastes, and obturation using 3D thermoplasticized carrier systems are evaluated. The review also discusses technological integration, including cone-beam computed tomography (CBCT) assisted diagnosis, enhanced canal shaping using NiTi rotary systems, and their implications for obturation selection. Comparative outcomes, advantages, disadvantages, and clinical considerations are included to provide a comprehensive understanding of contemporary obturation protocols. The article concludes by presenting future directions, including fully bioactive obturation systems, guided obturation, and nanotechnology driven solutions.

Keywords: Contemporary obturation, bioceramic sealers, warm vertical compaction, single cone technique, hydraulic condensation, gutta-percha, carrier based obturators, 3D obturation.

1. Introduction

Root canal obturation remains a cornerstone of endodontic therapy. Successful obturation aims to achieve a three dimensional fluid tight seal that prevents the ingress or egress of bacteria and their by products[1,19]. Traditionally, gutta-percha (GP) in conjunction with zinc oxide eugenol sealers was used universally[2]. Cold lateral condensation, a technique over a century old, was considered the gold standard due to its ease and predictability[1,2]. However, modern research and clinical outcomes have revealed significant limitations, particularly in complex anatomies, isthmuses, fins, and oval canals[3,4].

With the emergence of advanced rotary and reciprocating instrumentation systems, canal shapes have evolved from irregular, manually prepared spaces to smoother, tapered geometries[3,4,20]. This evolution has pushed scientists, clinicians, and manufacturers to develop obturation materials and techniques that complement these modern canal shapes. Additionally, research in biomaterials has introduced advanced sealers especially bioceramics capable of bonding chemically with dentin, promoting biological healing, and reducing shrinkage[9-12].

The concept of "contemporary obturation" is therefore not limited to the use of novel materials alone[5]. It encompasses a complete shift toward minimally invasive, biologically driven, technologically integrated endodontic practice. Contemporary obturation focuses on: Biocompatibility and bioactivity, Enhanced penetration into canal irregularities, Effective 3D sealing, Minimal sealer shrinkage and dissolution, Ease of use and reproducibility, Compatibility with modern canal shaping and Predictable outcomes and clinical success.

This article reviews the state of the art obturation materials, techniques, and philosophies that define modern endodontic

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practice.

2. Methods

Comprehensive literature search was conducted using databases such as PubMed, Scopus, Google Scholar, and Science Direct. Keywords included: "contemporary obturation," "bioceramic sealers," "single cone technique," "warm vertical compaction," "thermoplasticized obturation," "hydraulic condensation," and "carrier based systems[5]."

Inclusion criteria

- Peer-reviewed articles published between 2000 and 2024
- In vivo, in vitro, and systematic reviews addressing obturation materials or techniques
- Studies evaluating outcomes of different obturation protocols

Exclusion criteria

- Non-English articles
- Unpublished abstracts
- Studies focusing solely on pulp therapy without canal obturation

Over 180 relevant publications were screened, and approximately 110 were included for synthesis. Data were analyzed qualitatively to highlight current trends, scientific rationale, clinical evidence, and future perspectives in contemporary obturation.

3. Results

The review revealed three major trends that characterize contemporary obturation:

3.1. Evolution of Obturation Materials

3.1.1. Gutta-Percha Improvements

Gutta-percha remains the most widely used obturation core material[2,5]. Modern improvements include:

- Bioceramic coated cones (BC cones)[9,10]
- Nanoparticle infused GP improving flow and adaptation[9,10]
- Thermoplastic GP formulations for warm techniques[9,10]

Despite its long history, GP continues to evolve as a versatile, reliable, and biocompatible obturation material[2,5].

3.2. Evolution of Root Canal Sealers

3.2.1. Zinc Oxide Eugenol (ZOE) Sealers

Traditional ZOE sealers (e.g., Roth's) have excellent antimicrobial properties but exhibit shrinkage, dissolution, and cytotoxicity[7].

3.2.2. Resin Based Sealers

Advances include

- AH Plus: gold standard resin sealer
- Epoxy resin based sealers with high dimensional stability

Limitations include polymerization shrinkage and inability to bond strongly to GP[8].

3.2.3. Bioceramic Sealers

The most significant advancement in obturation science[9,10].

These sealers are:

- Hydrophilic
- Expand upon setting
- Chemical bonding with dentin
- High pH, antimicrobial
- Bioactivity (hydroxyapatite formation)

Examples include EndoSequence BC Sealer, BioRoot RCS, Total Fill BC Sealer.

These sealers enable predictable single cone obturation with high success rates[11].

3.3. Advancement in Obturation Techniques

3.3.1. Cold Lateral Condensation

Cold lateral condensation is simple and inexpensive but shows poor adaptation in irregular canal spaces.

Still used but no longer preferred in contemporary protocols[1,3].

3.3.2. Warm Vertical Compaction (Schilder Technique)

A hallmark of advanced obturation providing excellent 3D sealing, Best adaptation to canal irregularities, Homogeneous mass of GP and Predictable 3D obturation[1,15].

However, the technique is time consuming and technique-sensitive with risk of extrusion[16].

3.3.3. Continuous Wave Compaction

A modern simplified version of classic warm vertical compaction using Downpack heat, Backfill with thermoplastic GP and good control and adaptability[15,16].

Systems include: Elements Free, System B.

3.3.4. Carrier Based Obturation Systems

Carrier based obturators such as Thermafil and GuttaCore provide fast and consistent obturation[13].

However, retreatment is difficult and carrier separation may occur[18].

3.3.5. Thermoplasticized Injectable GP

Used with devices like Obtura II, Beefill, Calamus.

Injectable obturation systems show excellent flow into complex canal anatomy[14].

However, they are technique-sensitive with risk of overfilling[14].

3.3.6. Single Cone Hydraulic Condensation

Single cone obturation with bioceramic sealers represents the hallmark of contemporary obturation[12].

Clinical studies demonstrate outcomes comparable or superior to warm vertical compaction[1].

3.4. Minimally Invasive Endodontics (MIE) and Obturation

Shaping philosophies like TruNatomy, XP-endo, and adaptive NiTi systems emphasize dentin conservation. These canal shapes often favor:

- Single cone BC techniques
- Hydraulics
- Limited warm compaction

MIE has shifted obturation away from aggressive vertical compaction[22].

3.5. Outcome Studies

The review found:

- Bioceramic sealers show higher periapical healing rates.
- Single cone techniques with BC sealers demonstrate success comparable or superior to warm vertical compaction.
- Carrier based systems yield excellent obturation quality, especially in complex canals.
- Warm vertical compaction remains the gold standard for 3D accuracy, especially in large, irregular canals.

4. Discussion

Contemporary obturation is no longer viewed simply as the act of filling a prepared root canal but as a biologically driven process aimed at creating a stable environment that prevents reinfection and supports long-term periapical healing[1,19]. Modern materials especially bioceramic sealers have transformed this phase of treatment by providing bioactivity, dentin bonding, high pH antimicrobial effects, and chemical stability. These properties allow the sealer to seal effectively while also contributing to tissue healing, reflecting the shift in endodontics toward biologically oriented care[9-12].

The comparison between different obturation techniques shows how contemporary practice balances efficiency, conservativeness, and sealing quality[16-18]. Warm vertical compaction continues to offer excellent adaptation of gutta-percha but requires greater operator skill and more dentin removal[1,5,16]. In contrast, the single cone technique used with bioceramic sealers has gained popularity because it is simple, minimally invasive, and compatible with modern NiTi-prepared canal shapes[9-12]. For many clinicians, this technique provides predictable results while preserving tooth structure[16-18]. Thermoplasticized injectable obturation remains useful in cases with complex anatomy, providing good flow into fins and lateral canals; however, it is technique sensitive[14]. Carrier based systems provide speed and consistency but can be difficult to remove during retreatment[13,18].

Technological advancments have contributed significantly to improved obturation outcomes. CBCT imaging helps clinicians identify variations in canal morphology and select the appropriate obturation approach[21]. NiTi rotary and reciprocating systems create uniform tapers that enhance the predictability of single cone hydraulic condensation[3,20]. Use of magnification and ultrasonics improves precision in cleaning and placement of materials, further supporting the effectiveness of modern obturation strategies[20,21].

Despite these advantages, certain limitations persist[18]. Bioceramic sealers may present challenges during retreatment due to their strong bonding to dentin[18]. Additionally, although widely used, some newer materials still lack extensive long-term clinical evidence[17,25]. Thermal techniques remain sensitive to operator skill and may lead to voids or overfills if incorrectly performed[16].

Looking ahead, future directions include development of fully bioactive obturation materials capable of promoting dentin regeneration, nanotechnology enhanced sealers with superior flow and antimicrobial action, and AI-guided obturation planning based on CBCT analysis. These advancements aim to make obturation more biologically active, precise, and predictable[12,24].

5. Conclusion

Contemporary obturation represents a major shift in endodontic science. Bioceramic sealers are the most impactful innovation of modern obturation[9-12.] Single cone techniques demonstrate excellent outcomes due to material advancements[1].

The trend toward minimally invasive endodontics favors simplified obturation systems supported by advanced materials[22].

Key conclusions

- Bioceramic sealers are the most impactful innovation of modern obturation.
- Single cone techniques, once considered inferior, now demonstrate excellent outcomes due to material advancements.
- Complex anatomies continue to benefit from warm vertical compaction and thermoplasticized GP.
- Carrier based obturators offer consistent, fast obturation but pose retreatment challenges.
- The trend toward minimally invasive endodontics favors simplified obturation systems supported by advanced materials.

References

1. Schilder H. Filling root canals in three dimensions. Dent Clin North Am. 1967;11(2):723–44.
2. Ingle JI, Bakland LK, Baumgartner JC. Ingle's Endodontics. 6th ed. Hamilton: BC Decker; 2008.
3. Peters OA. J Endod. 2004; 30 (8): 559–67.
4. Gutmann JL, Gao Y. Int Endod J. 2012; 45 (8): 725–33.
5. Ørstavik D. Endod Topics. 2005;12 (1): 25–38.
6. Mohammadi Z, Dummer PMH. Int Endod J. 2011; 44 (8): 697–730.
7. Grossman LI. J Endod. 1976; 2 (6): 166–75.
8. De Deus G, et al. J Endod. 2007; 33 (8): 987–90.
9. Zhang W, Li Z, Peng B. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2009;107 (6): e79–82.
10. Koch K, Brave D. Endod Pract. 2009; 2 (1):17–21.
11. Candeiro GTM, et al. J Endod. 2012; 38 (6): 842–5.
12. Camilleri J. J Dent. 2013; 41(7): 600–10.
13. Schäfer E, Olthoff G. J Endod. 2002; 28 (9): 638–42.
14. Gencoglu N. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2003;96(1):91–5.
15. Buchanan LS. Endod Pract. 1994; 7 (3):13–6.
16. Peng L, et al. J Endod. 2007; 33 (2):106–9.
17. De-Long C, He J. J Endod. 2020; 46 (3): 367–72.
18. Kim HC, et al. J Endod. 2015; 41(9):1501–5.
19. Siqueira JF Jr, Rôças IN. J Endod. 2008; 34 (11):1291–301.
20. Plotino G, et al. J Endod. 2009; 35 (11): 1469–76.
21. Patel S, et al. Int Endod J. 2007; 40 (10): 818–30.
22. Clark D, Khademi J. Dent Clin North Am. 2010;54 (2):249–73.
23. Torabinejad M, Parirokh M. J Endod. 2010;36 (2):190–202.

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Role of Surface tension and Viscosity of Endodontic Irrigants in Cleaning and Shaping of Root Canals

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Abstract

Effective endodontic therapy depends not just on mechanical instrumentation, but critically on chemical irrigation to remove microbes from inaccessible areas of the root canal system. Among the key physicochemical factors, surface tension and viscosity govern how well irrigants can penetrate, wet, and clean complex canal anatomy. Lower surface tension improves irrigant spreading and canal penetration, while optimal viscosity supports efficient flow and debris removal. Recent innovations including surfactant addition, temperature adjustment, and advanced activation methods are designed to enhance these properties, resulting in better debridement and microbial control. This review delves into the intricate mechanisms by which surface tension and viscosity modulation enhance the performance of endodontic irrigants, highlighting their profound clinical implications in achieving superior root canal disinfection and improving treatment outcomes.

Keywords: Surface tension, Viscosity, Endodontic irrigants, Root canal irrigation, Wettability, Debridement, Activation techniques, Penetration.

Introduction

The long-term success of endodontic treatment relies on three essential principles: cleaning and shaping of the root canal, effective disinfection, and three dimensional obturation. The elimination or significant reduction of microorganisms within the root canal system remains the primary therapeutic goal. However, the complex root canal anatomy including isthmuses, fins, curvatures, intercanal communications, and lateral canals poses significant challenges to complete disinfection[1,2]. Although mechanical instrumentation aids in shaping the canal, large portions of canal walls remain untouched, underscoring the indispensable role of irrigants [3].

The effectiveness of root canal irrigants is determined not only by their antimicrobial and tissue-dissolving properties but also by their physicochemical characteristics particularly:

1. Surface tension
2. Viscosity

High surface tension restricts the ability of irrigants to penetrate dentinal tubules and anatomical complexities. Lowering surface tension, either by the addition of surfactants or heating, enhances wettability and improves irrigant penetration into inaccessible canal ramifications. Likewise, viscosity plays a crucial role by influencing flow dynamics within narrow canals. Reduction in viscosity facilitates deeper penetration and spread of irrigants into apical and lateral spaces, improving debris and biofilm elimination.

Therefore, optimal irrigation protocols must be guided by a dual focus: the selection of irrigants with proven chemical efficacy and the modification of their surface tension and viscosity to enhance penetration. This integration ensures improved disinfection of the complex root canal system, thereby contributing significantly to the overall success of endodontic therapy.

This article emphasizes the crucial impact of surface tension and viscosity in determining the effectiveness of endodontic irrigants, and explores current advances and clinical approaches aimed at modifying these properties, thereby improving irrigant penetration and disinfection of the complex root canal anatomy.

Historical Perspectives

Historical contributions, from Hunter's oral sepsis concept in 1910 to Grossman's acknowledgment of canal complexity, highlight the difficulty of eradicating infection from such intricate morphology[4,5]. Studies by Bystrom

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and Sundqvist further demonstrated that while instrumentation and saline irrigation reduce bacterial counts, effective disinfection requires potent chemical irrigants such as sodium hypochlorite (NaOCl), often in combination with chelating agents like EDTA[6]. The dictum "instruments shape, irrigants clean" aptly summarizes their complementary roles.

Physicochemical Properties of Irrigants

Surface Tension

Surface tension is defined as the force between molecules that produces the tendency for a liquid's surface area to decrease, originating from cohesive van der Waals forces that pull molecules inward at the liquid interface[7]. When an irrigants surface tension decreases, it spreads more effectively over dentin surfaces, improving contact with canal walls and debris. This spreading is critical for effective irrigation and biofilm disruption in root canal systems.

Irrigants with high surface tension inadequately wet dentinal walls and fail to penetrate into dentinal tubules, lateral canals, and isthmuses where resilient microbial biofilms persist [8,9]. Lowering surface tension by adding surfactants or by heating improves wettability and capillary action, thus enhancing irrigant access to complex anatomy[10,11]. This leads to better debris removal, smear layer disruption, and microbial elimination.

Several factors influence the surface tension of endodontic irrigants, including surface roughness of dentin, pH, temperature, and importantly, the addition of surfactants[9]. Surfactants reduce surface tension by disrupting intermolecular forces, with maximal wetting achieved at the critical micellar concentration (CMC), where micelle formation stabilizes surface tension[9,12]. Experimental additions of surfactants to calcium hypochlorite, sodium hypochlorite, and EDTA solutions have demonstrated significant reductions in surface tension and improved wetting, facilitating better irrigant penetration and flow within the canal[10,13].

The pH of irrigants also impacts surface tension and solubility. Acidic conditions enhance the chelating efficacy of EDTA, increase tooth mineral solubility, and improve irrigant penetrability into dentinal tubules[12,13]. Irrigants with lower surface tension, such as MTAD and Tetraclean, characterized by acidic pH and surfactant presence, demonstrate superior smear layer removal and antibacterial activity due to enhanced penetration[14,15].

Low surface tension irrigants improve lubrication and allow access to difficult anatomical sites such as lateral canals and isthmuses, promoting effective debris and biofilm removal and reducing the risk of reinfection[16,17]. Furthermore, these irrigants reduce intracanal pressure, minimizing extrusion risk and potential complications[18].

In modern endodontics, sodium hypochlorite and chlorhexidine remain the mainstay irrigants during cleaning and shaping due to their antimicrobial and tissue dissolving properties. Chelators such as EDTA, citric acid, and phosphoric acid assist in smear layer removal, while antioxidants like sodium thiosulfate and sodium ascorbate restore dentin bonding strength prior to coronal sealing, with all these processes benefiting from optimized surface tension to ensure intimate dentin contact[19,20].

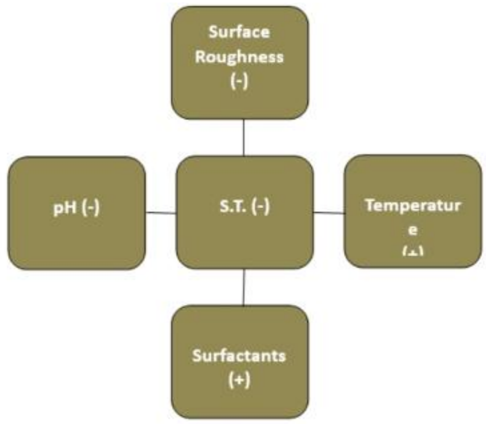

Diagram 1: Showing the factors affecting the surface tension of an endodontic irrigant.

Viscosity

Viscosity, defined as the internal resistance of a fluid to flow induced by shear or tensile stress, is a critical factor influencing the behaviour of irrigants within the root canal system[11]. This property arises from molecular interactions and collisions among fluid particles moving at variable velocities. Several parameters affect viscosity, including temperature, pressure, composition of irrigants, and the presence of chemical additives such as surfactants[9].

Numerous studies confirm that increasing temperature lowers the viscosity of common irrigants like sodium hypochlorite and EDTA, thereby enhancing their flow characteristics and penetration into complex canal anatomies[11,17]. Thermal agitation of molecules reduces internal friction, facilitating smoother irrigant dynamics. Conversely, higher concentration of sodium hypochlorite correlates with increased viscosity, potentially hindering fluid flow, although the addition of surfactants near their critical micellar concentration can decrease viscosity, balancing irrigant performance[9].

Low viscosity irrigants flow more easily through narrow and tortuous canals, improving mechanical flushing and debris transport. However, excessively low viscosity may reduce irrigant retention time on canal walls, potentially limiting antimicrobial effects[18]. Heating irrigants reduces viscosity by increasing molecular kinetic energy, thus improving flow characteristics and penetration into dentinal tubules[19].

Optimal viscosity ensures effective distribution of irrigants throughout the root canal, including lateral canals and dentinal tubules, supporting enhanced debris removal and antimicrobial efficacy[19,20]. Moreover, controlled viscosity assists in maintaining irrigation precision, minimizing excessive pressure and the risk of apical extrusion[20].

"An optimal balance between viscosity and surface tension is critical for effective irrigant performance."

Common Endodontic Irrigants and their Properties

- Sodium Hypochlorite (NaOCl): Widely used due to tissue dissolution and antimicrobial activity. Heating reduces surface tension and viscosity but increases cytotoxic risk[21,22].

- Chlorhexidine (CHX): Effective against resistant bacteria but lacks tissue dissolution. Surface tension decreases with higher concentration and temperature[23].
- EDTA: Chelator for smear layer removal; high surface tension limits penetration. Surfactant addition enhances wettability[24].
- Other Solutions: Citric acid, MTAD, herbal irrigants, and nano-particle based irrigants show potential but need further validation[25,26].

Methodology

A literature search was conducted using PubMed, Google Scholar, and Research Gate databases, focusing on articles related to the physicochemical properties of endodontic irrigants, particularly surface tension and viscosity. Keywords included "viscosity," "surface tension," "root canal irrigants," and "properties of endodontic irrigants." Inclusion criteria were original research, basic science studies, case reports, and reviews examining the direct or indirect impact of surface tension and viscosity on irrigant performance and endodontic treatment outcomes.

Modern Irrigant Activation Techniques

- Heating and Intracanal Activation: Preheating NaOCl reduces viscosity and surface tension, enhancing tissue dissolution and antimicrobial activity[27].
- Manual, Sonic, and Ultrasonic Agitation: Passive ultrasonic irrigation (PUI) generates acoustic streaming and cavitation, improving penetration into lateral canals[27].
- Apical Negative Pressure and Laser Activation: EndoVac and laser activated irrigation enhance irrigant delivery to the apical third while minimizing extrusion[28].

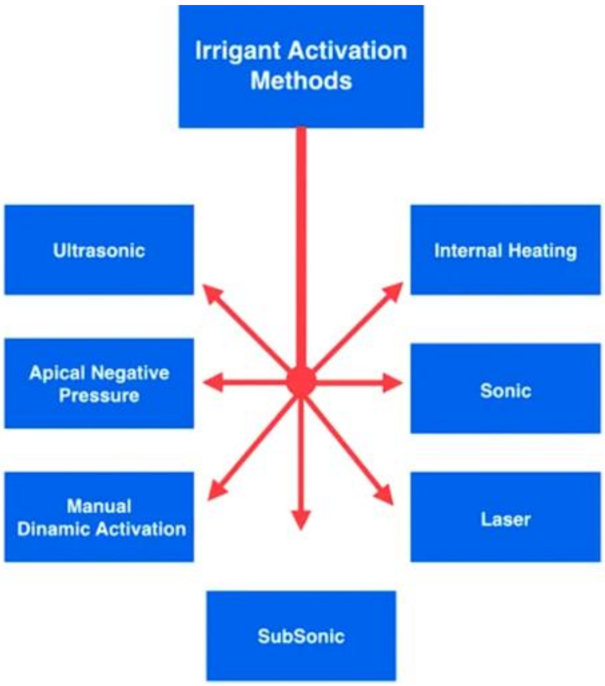

Figure 1: Graphic overview of irrigant activation methods

Results

The reviewed literature consistently demonstrated that reduced surface tension significantly improves irrigant wettability and penetration into dentinal tubules and lateral canals, while lower viscosity enhances irrigant flow, debris suspension, and mechanical flushing. Heating and surfactant addition favourably modify both surface tension and viscosity. Activation techniques amplify the benefits of optimized physicochemical properties, resulting in improved smear layer removal and antimicrobial efficacy.

Discussion

Effective cleaning and shaping of the root canal system cannot be achieved by mechanical instrumentation alone, particularly in anatomically complex canals. Peters et al. demonstrated that a substantial portion of canal walls remains untouched after instrumentation, emphasizing the indispensable role of chemical irrigation in achieving adequate disinfection[1].

Surface tension is a critical determinant of irrigant wettability and penetration. De Gennes et al. explained that liquids with high surface tension resist spreading and capillary penetration, limiting access to dentinal tubules and lateral canals[8]. Bukiet et al. reported that conventional irrigants such as sodium hypochlorite and EDTA exhibit relatively high surface tension; however, the addition of surfactants significantly improves dentin wettability and irrigant distribution[9]. Yılmaz et al. further demonstrated increased dentinal tubule penetration with surfactant modified irrigants[10].

Low surface tension irrigants such as MTAD and Tetraclean have shown superior smear layer removal and antibacterial efficacy due to enhanced penetration, as reported by Giardino et al. and Mohammadi et al.[14,15]. Additionally, Al-Jadaa et al. observed that reduced surface tension lowers intracanal pressure, thereby minimizing the risk of apical extrusion and associated periapical complications[16].

Viscosity also plays a crucial role in irrigant performance by influencing flow dynamics and debris removal. Poggio et al. demonstrated that elevated temperature reduces the viscosity of sodium hypochlorite and EDTA, enhancing flow and penetration into complex canal anatomies[11]. Bukiet et al. corroborated these findings, reporting improved irrigant dynamics with thermal activation[17]. However, excessively low viscosity may reduce irrigant contact time, potentially compromising antimicrobial efficacy[18].

Computational and experimental studies by Boutsioukis et al. showed that irrigants with optimal viscosity generate favorable shear stress along canal walls, improving debris removal while minimizing apical pressure[19]. Zehnder emphasized that controlled viscosity is essential to ensure safe irrigation and prevent irrigant extrusion beyond the apical foramen[20].

Modern activation techniques further enhance the benefits of optimized surface tension and viscosity. Haapasalo et al. demonstrated that passive ultrasonic irrigation significantly improves irrigant penetration and smear layer removal through acoustic streaming and cavitation[27]. Laser activated irrigation and apical negative pressure systems have also been shown to enhance irrigant delivery to the apical third while reducing extrusion risk[28].

Clinical Implications

Selecting irrigants with low surface tension and optimal viscosity enhances cleaning efficiency, penetration, and clinical outcomes in root canal therapy. A balanced approach tailoring irrigant choice and technique to the case maximizes the effectiveness of shaping and cleaning, though instrumentation, sealers, and procedural strategy remain key contributors to overall endodontic success.

Future Directions and Strategies

Emerging strategies include the addition of surfactants and thermally activated irrigants to modify surface tension and viscosity favourably. Advances in irrigation devices, such as ultrasonic and laser assisted activation, further augment the physical properties of irrigants, enhancing penetration and antimicrobial activities[28]. The development of novel irrigants with inherently low surface tension and controlled viscosity remains a critical area for future research.

Conclusion

Endodontic success depends on eliminating microbes and smear layers during cleaning and shaping. Surface tension and viscosity critically affect irrigant performance: low surface tension improves penetration while optimal viscosity ensures effective flow and contact time. Proper formulation and activation improve disinfection, boosting treatment outcomes. Clinicians must balance these properties alongside instrumentation and sealers to maximize success.

References

1. Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. J Endod. 2004; 30 (8): 559–567.
2. Haapasalo M, Shen Y, Qian W, Gao Y. Irrigation in endodontics. Dent Traumatol. 2005; 21(4): 218–229.
3. Siqueira JF Jr, Rocas IN. Microbiology and treatment of endodontic infections. Dent Clin North Am. 2006; 50:1–26.
4. Hunter W. Oral sepsis as a cause of disease. Lancet. 1910; 1: 1111–1117.
5. Grossman LI. Endodontic practice. 9th ed. Philadelphia: Lea & Febiger; mid-20th century.
6. Bystrom A, Sundqvist G. Bacteriologic evaluation of the effect of 1% sodium hypochlorite on infected root canals. Odontol Revy. 1983; 34 :321–328.
7. Zoethout RJ, Tuttle R, Philips RW. Surface tension principles. J Dent Res. 2002; 81 (12) :833–839.
8. De Gennes PG, Brochard-Wyart F, Quere D. Capillarity and wetting phenomena: drops, bubbles, pearls, waves. Springer; 2004.
9. Bukiet F, et al. Influence of surfactants on endodontic irrigant penetration. Int Endod J. 2012; 45: 675–683.
10. Yılmaz K, et al. Effects of surfactant modified irrigants on dentin penetration. J Endod. 2013; 39: 484–488.
11. Poggio C, et al. Effects of temperature on irrigant viscosity and flow. Int Endod J. 2015; 48: 924–930.
12. Iglesias E, et al. Critical micellar concentration of surfactants in irrigants. J Clin Dent. 2010; 21:155–160.
13. Coaguila-Llerena H, et al. Surfactant enhanced irrigant penetration. Aust Endod J. 2011; 37: 53–57.
14. Giardino L, et al. MTAD: an alternative endodontic irrigant. J Endod. 2005; 31: 610–613.
15. Mohammadi Z, et al. Tetraclean and smear layer removal. Int Endod J. 2012; 45: 242–247.
16. Al-Jadaa A, et al. Surface tension and apical pressure in root canal irrigation. Int Endod J. 2011; 44: 327–334.
17. Torabinejad M, et al. Sodium hypochlorite and chlorhexidine in root canal therapy. J Endod. 2007; 33: 186–191.
18. Karimi T, et al. Effect of irrigant properties on dentin bonding. Dent Mater J. 2015; 34: 865–872.
19. Boutsioukis C, et al. Computational fluid dynamics of root canal irrigation. Int Endod J. 2010; 43: 832–841.
20. Zehnder M. Root canal irrigants. J Endod. 2006;32:389–398.
21. Heggers JP, et al. Antimicrobial properties of NaOCl. J Surg Res. 1988; 44: 641–648.
22. Zhang H, et al. Temperature effect on NaOCl cytotoxicity. J Endod. 2003; 29: 462–465.
23. Giardino L, et al. Chlorhexidine and irrigant properties. J Endod. 2015; 41: 178–182.
24. Iwanami-Kurosaki H, et al. EDTA surfactant effect. Int Endod J. 2015; 48: 1025–1031.
25. Murray PE, et al. Herbal irrigants in endodontics. Int Endod J. 2008; 41: 963–970.
26. Kumar A, et al. Nanoparticle irrigants in endodontics. J Dent Res. 2015; 94: 1481–1487.
27. Haapasalo M, et al. Ultrasonic activation in endodontics. Endod Topics. 2014; 30: 84–104.
28. Gaddalay S, et al. Advanced irrigant activation techniques. J Conserv Dent. 2018; 21: 245–251.

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Prosthetic Management of Missing Anterior teeth with Maryland Bridge as a Minimally Invasive treatment Modality

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Abstract

An anterior tooth loss presents a functional, aesthetic, and rehabilitation challenge, particularly for individuals in the younger age range. For these patients, a minimally invasive option for function and aesthetic restoration is a resin bonded fixed partial denture. A kind of resin bonded bridge called a Maryland bridge includes supragingival borders, which prevent pulp stress and preserve periodontal health. The Maryland bridge is described in this case study as a successful treatment option for replacing lost anterior teeth.

Keywords: Maryland bridge, minimally invasive, restoration.

Introduction

Young patients experience significant psychological effects in addition to functional loss when their anterior teeth are lost. The replacement of the lost maxillary lateral incisor is crucial because the empty space in the maxillary anterior region affects the patient's mental health, particularly if they are a young patient. There are a number of treatment options available for replacing lost maxillary incisors, including fixed partial dentures, removable partial dentures, and implants. Because it may result in bone resorption and the flattening of the interdental papillae with prolonged use, a removable partial denture can be utilized as an interim prosthesis for initial esthetics. In order to replace the missing tooth and preserve the remaining alveolar ridge and soft tissue, a more conservative and less invasive resin bonded prosthesis may be an alternative treatment for conditions like these because of the large pulp chambers and lack of sufficient enamel.[2,3] Implants are a superior treatment option, but where they are placed depends on a number of variables, such as the patient's preferences, the quantity of available bone, and a number of medical and financial considerations.[1]

In this case study, the maryland bridge is used as a successful, minimally invasive treatment option to replace the missing maxillary anterior lateral incisor.[4]

Case Report

A 36 year old female patient visited the Department of Prosthodontics with concerns about the unesthetic appearance caused by the loss of her upper anterior teeth. She reported a history of tooth extraction following trauma to the upper anterior region, which had occurred six months prior. Upon intraoral examination, the right lateral incisor was found to be missing, accompanied by a slight rotation of the right canine.(Figure 1A).

Fig. 1a and 1b: Intraoral mandibular view showing missing left central incisor

A concavity was present labially in the region of the missing central incisor. All the treatment options including implant, conventional fixed dental prosthesis, removable partial denture, and resin bonded bridges were given to the patient. The patient was not willing for any invasive treatment option, so implants were opted out. She was willing for fixed prosthesis with minimal tooth reduction, so resin bonded bridges were chosen as the treatment option for the patient.

Technique

Both the maxillary and mandibular arch diagnostic impressions were made. Diagnostic casts were obtained and the wax up for the missing tooth was done. Tooth preparation was done on the lingual surfaces of the right

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central incisor and right canine (13 and 11) with a chamfer finish line prepared supra-gingivally.

The incisal end of the tooth preparation was kept 1mm cervical from the incisal edge (Figure 2).

Fig. 2: Tooth preparation on the lingual surface of 11 and 13 teeth.

Fig. 3: Final impression of the mandibular arch using double step putty wash impression technique.

Gingiva was retracted using the retraction cord and the final impression was made using the two step putty wash impression technique using additional silicone impression material (Figure 3). Indirect temporization was done and the provisional restoration was luted using temporary non eugenol based cement (Figure 4).

Fig. 4: Frontal view of temporization of the left lateral incisor

Fig. 5: A): Intraoral frontal view showing the maryland bridge cemented to the adjacent teeth, B): Intraoral mandibular view showing the lingual surface of the final prosthesis.

The nickel chromium metal framework was fabricated and try in was done, followed by ceramic build up on the lateral incisor. The prosthesis was finished, polished and glazed. The final prosthesis was luted using the self-etch resin cement (Rely X U200,3M ESPE, Germany) on the abutment teeth (Figure 5). The occlusion was assessed and post cementation instructions were given to the patient. Patient was kept on follow-up at regular intervals and she was satisfied with the result.

Discussion

Pulp chambers in fixed partial dentures are so large, hence tooth preparation of all abutment teeth surfaces is necessary for the restoration of missing teeth. In younger patients, this can result in pulp damage. In such a situation, resin bonded fixed dental prostheses are a useful option. The University of Maryland developed the "Maryland Bridge," a fixed dental prosthesis that is bonded with resin. The retention of the resin bonded prosthesis has improved due to the development of new resin cements that chemically bond to the etched metal alloy as well as the tooth surface[3,5]. Micromechanical retention is utilized to maintain the integrity of the Maryland Bridge. Only non-precious alloys can be used with the alloy-specific Maryland bridges because precious alloys cannot be etched to provide the micromechanical retention.

A Maryland bridge has a number of benefits, such as less tooth preparation to preserve the enamel, less pulpal trauma, a lower risk of causing gingival irritation, a single path of insertion to prevent displacement, improved aesthetics, patient satisfaction, and the avoidance of the need for local anesthetic[6,7]. But it also has some drawbacks, such as the technique-sensitive application and the metal retainer's propensity to show through the thin anterior teeth.[8,9]

A few things to think about when choosing a case are parafunctional habits, periodontal diseases, adequate occlusal clearance, no severe rotation or malpositioning of the abutment teeth, and adequate thickness of enamel. A few things to think about when choosing a case are parafunctional habits, periodontal diseases, adequate occlusal clearance, no severe rotation or malpositioning of the abutment teeth, and adequate thickness of enamel.

Conclusion

A successful method of replacing lost teeth, restoring function and aesthetics, and enhancing patient confidence is with resin bonded bridges. When it comes to small span restorations, resin bonded bridges ought to be given more consideration. This is especially true when careful patient evaluation and prudent clinical techniques are employed.

References

1. Gupta R, Gupta N, Weber KK. Dental Implants. [Updated 2021 Aug 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022.
2. Negi P, Jaikaria A. Rehabilitation of Patient with Missing Anterior Tooth with Maryland Bridge : A Case Report. Int J Res Rev. 2020; 7 (6):1–3.
3. Ahmad M, Naim H, Meshni AA, Siddiq A. A conservative approach to replace missing teeth in the aesthetic zone with A conservative approach to replace missing teeth in the aesthetic zone with Maryland bridge - A case report. Dent Oral Craniofac Res. 2017;3(4):1–3.
4. Qiu HY, Wu SY, Fu L. Clinical performance of cantilevered resinbonded fixed partial dentures for single tooth replacement in elderly patients. J Int Med Res. 2020; 48 (10): 1–6.
5. Berekally TL, Smales RJ. A retrospective clinical evaluation of resin bonded bridges inserted at the Adelaide Dental Hospital. Aust Dent J. 1993; 38 (2): 85–96.
6. Miller TE. Reverse Maryland Bridges: Clinical Applications. J EsthetRestor Dent. 1989;1(5):155–63.
7. Miettinen M, Millar BJ. A review of the success and failure characteristics of resin-bonded bridges. Br Dent J. 2013; 215 (2): 3.
8. Khatavkar RA, Hegde VS. A conservative treatment option for a single missing premolar using a partial veneered restoration with the SR Adoro system. J Conserv Dent. 2010;13(2):102–5.
9. Prathyusha P, Kaul JS, Sethi RB, Bridge NM. An Interim Prosthesis for Tooth Replacement in Adolescents. Int J Clin Pediatr Dent. 2011; 4 (2):135–8.

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Orthodontic Indices: Concepts, Classification, and Clinical Applications: A Narrative Review

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Abstract

Orthodontic indices are standardized tools designed to quantify malocclusion, assess treatment need, determine treatment complexity, and evaluate treatment outcomes. They play a crucial role in clinical decision-making, epidemiological surveys, resource allocation, and quality assurance in orthodontics. Over the years, multiple indices have been developed, ranging from diagnostic classifications to epidemiologic, treatment priority, complexity, and outcome indices. This review provides a concise overview of the evolution, indications, advantages, and limitations of commonly used orthodontic indices, including Angle's classification, Occlusal Index, Little's Irregularity Index, Treatment Priority Index, Dental Aesthetic Index, Index of Orthodontic Treatment Need, and Index of Complexity, Outcome and Need. Recent advances, including the application of artificial intelligence, are also discussed.

Keywords: Orthodontic indices, Malocclusion, Treatment need, Epidemiology, Outcome assessment

Introduction

Ideal dental occlusion is essential for optimal oral function, facial esthetics, and long term dental health. Malo cclusion, however, is common and varies widely in severity and presentation. The subjective nature of orthodontic diagnosis and treatment planning necessitated the development of objective tools capable of recording, comparing, and quantifying occlusal deviations.

Orthodontic indices are numerical or categorical systems that describe malocclusion on a graded scale with defined limits. They allow standardized assessment of prevalence, severity, treatment need, complexity, and treatment outcome, thereby enabling comparisons across populations, clinicians, and treatment modalities. No single index is universally ideal, but each serves a specific purpose depending on clinical or epide miological requirements.

Classification of Orthodontic Indices

Orthodontic indices may broadly be classified into:

1. Diagnostic classifications
2. Epidemiologic indices
3. Treatment priority (need) indices
4. Treatment complexity indices
5. Treatment outcome indices

Diagnostic Classification

Angle's Classification of Malocclusion

Angle's classification remains the most widely used diagnostic system based on the anteroposterior molar relationship. It categorizes malocclusion into Class I, Class II (Divisions 1 and 2), and Class III. Despite its simplicity and universal acceptance, it does not assess severity, transverse or vertical discrep - ancies, or distinguish between skeletal and dental components.

Figure 1. Angle's classification of malocclusion showing Class I, Class II (Div 1 & 2), and Class III molar relationships.

Epidemiologic Indices

Epidemiologic indices are designed to record the prevalence and distribution of malocclusion in populations.

Occlusal Index (Summers, 1971)

The Occlusal Index objectively evaluates

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malocclusion using nine characteristics, including molar relationship, overjet, overbite, crossbite, tooth displacement, and missing teeth. Scores reflect the severity of occlusal disorder and facilitate population-based comparisons.

Little's Irregularity Index

Little's Irregularity Index quantifies mandi-bular anterior crowding by measuring the linear displacement of contact points between the six lower anterior teeth. It is simple, reproducible, and widely used in clinical audits and relapse studies, though it does not account for vertical or transverse discrepancies.

Index	Developer/ Year	Primary Purpose	Key Limitations
Occlusal Index (OI)	Summers, 1971	Quantifies severity of malocclusion for epidemiologic studies	Low reproducibility; limited assessment of dynamic occlusion
Facial Diagnostic Index (FDI)	Baumrind, 1966	Evaluates facial proportions and soft tissue esthetics	Influenced by soft-tissue variability; subjective elements
Little's Irregularity Index	Little, 1975	Measures mandibular anterior crowding	Does not assess vertical, transverse, or esthetic factors

Table 1. Epidemiologic orthodontic indices and their applications Treatment Priority (Need) Indices

Treatment priority indices rank patients according to the urgency of orthodontic intervention.

Treatment Priority Index (TPI)

Developed by Grainger, the TPI combines multiple occlusal traits into a single numerical score to assess malocclusion severity and treatment priority. It has been extensively used in public health orthodontics.

Dental Aesthetic Index (DAI)

The DAI links clinical measurements with social perceptions of dental esthetics, producing a single score that categorizes treatment need into four levels. While effective for epidemiological screening, it focuses primarily on esthetics.

Index of Orthodontic Treatment Need (IOTN)

The IOTN comprises a Dental Health Component and an Aesthetic Component, allowing assessment of both functional impairment and perceived esthetic need.

Treatment Complexity and Outcome Indices

Treatment Complexity Index (TCI)

The TCI estimates the technical difficulty and resource requirements of orthodontic treatment, aiding in case allocation and informed consent.

Treatment Outcome Index (TOI)

Outcome indices objectively evaluate treatment success by comparing pre- and post-treatment occlusion, supporting quality assurance and clinical audit.

Index	Developer/ Year	Primary Focus	Clinical Use
Treatment Priority Index (TPI)	Grainger, 1967	Severity of malocclusion	Ranking patients according to treatment urgency
Dental Aesthetic Index (DAI)	Cons et al., 1986	Dental esthetics	Screening and public health resource allocation
Index of Orthodontic Treatment Need (IOTN)	Brook & Shaw, 1989	Dental health & esthetics	Identifying orthodontic treatment need
Index of Complexity, Outcome and Need (ICON)	Daniels & Richmond, 2000	Need, complexity & outcome	Case selection, treatment planning, audit

Table 2. Treatment Priority Orthodontic Indices and Their Clinical Indications

Figure 2. Pre- and post-orthodontic treatment comparison used for outcome assessment

Advances in Orthodontic Indices

Recent advances include the incorporation of artificial intelligence for automated landmark detection, occlusal trait scoring, and prediction of treatment need. AI-based systems promise increased objectivity, efficiency, and reproducibility, although large-scale validation and ethical considerations remain essential.

Limitations of Orthodontic Indices

Despite their utility, orthodontic indices have limitations. Most fail to capture functional dynamics, patient perception, and psychosocial impact comprehensively. Therefore, indices should supplement not replace comprehensive clinical judgment.

Conclusion

Orthodontic indices are indispensable tools in modern orthodontics, enabling standardized diagnosis, epidemiological assessment, treatment prioritization, and outcome evaluation. While no single index fulfills all clinical requirements, appropriate selection and judicious application enhance objectivity and consistency in orthodontic care.

References

1. Angle EH. Classification of malocclusion. Dent Cosmos. 1899;41:248–264.
2. British Standards Institution. Glossary of Dental Terms. BS 4492. London: BSI; 1983.
3. Brook PH, Shaw WC. The development of an index of orthodontic treatment priority. Eur J Orthod. 1989; 11 (3) :30 9–320.
4. Richmond S, Shaw WC, Roberts CT, Andrews M. The PAR Index (Peer Assessment Rating): methods to determine outcome of orthodontic treatment in terms of improvement and standards. Eur J Orthod. 1992;14(3):180–187.
5. Russell AL. Epidemiology of oral disease. Public Health Rep. 1966;81(7):671–679.
6. Summers CJ. The occlusal index: a system for identifying and scoring occlusal disorders. Am J Orthod. 1971;59(6): 552–567.
7. Baumrind S. A reconsideration of the propriety of cephalometrics for clinical use. Am J Orthod. 1966;52 (9): 619–655.
8. Little RM. The irregularity index: a quantitative score of mandibular anterior alignment. Am J Orthod. 1975;68(5): 554–563.
9. Grainger RM. Orthodontic Treatment Priority Index. Public Health Service Publication No. 1000, Series 2, No. 25. Washington (DC): US Government Printing Office; 1967.

10. Daniels C, Richmond S. The development of the Index of Complexity, Outcome and Need (ICON). J Orthod. 2000;27(2):149–162.
11. Llewellyn SK, Hamdan AM, Rock WP. Index of orthodontic treatment complexity (IOTC). Eur J Orthod. 2007;29(2): 186 –192.
12. Cons NC, Jenny J, Kohout FJ. DAI: The Dental Aesthetic Index. Iowa City: University of Iowa; 1986.
13. O'Brien KD, Shaw WC, Roberts CT. The effectiveness of orthodontic treatment: a review of the literature. Am J Orthod Dentofacial Orthop. 1993;103(5):551–556.
14. Proffit WR, Fields HW, Sarver DM. Contemporary Ortho dontics. 6th ed. St. Louis: Elsevier; 2018.
15. Zhang C, He W, Chen B, et al. Artificial intelligence in ortho dontics: current applications, challenges, and future directions. Angle Orthod. 2023;93(4):505–516.

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Caries Excavation; Current Concepts and Techniques

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Abstract

Dental caries is a disease and the carious lesion is the disease's consequence and manifestation it's signs and symptoms. Carious lesion management is used to control the disease symptoms at the tooth level, whereas dental caries management is used to control the disease symptoms at the patient level using preventive and noninvasive methods. While it is impossible to link the clinical signs of carious lesions to their visual appearance, we have been able to do so indirectly, based on disease clinical outcomes (soft, leathery, firm, and hard dentine). The following are the methods for removing carious tissue: 1) selective carious tissue removal, including selective removal to soft dentine and selective removal to firm dentine; 2) stepwise removal, including stage 1 selective removal to soft dentine and stage 2 selective removal to firm dentine 6 to 12 months later; and 3) Previously known as full caries removal, nonselective removal to hard dentine (technique no longer recommended).

Introduction

Dental caries is one of the most commonly occurring disease in the world, and its treatment is expensive both financially and biologically (dental pain infection and tooth loss). Non operative therapies (plaque and diet control, fluoride application) are important for preventing caries progression. However, operative denti-stry (removal of carious tissue and placement of restorations) has a role to play in plaque control and restoration of tooth form and function.

Traditionally, the operative therapy for dental caries was to totally eliminate all remnants of carious tissue, allowing the restoration margins to rest on sound tooth structure. The bacteria infected carious tissue is excavated using a high/low speed bur or hand excavation devices (Kidd 1998) Den-tinal caries has been classified histologically and clinically into two layers: the outer zone (stains with caries detector dyes) where the dentine is highly demineralized, the collagen denatured, and heavily infected with bacteria (often referred to as the infected zone), and the inner zone (does not stain with a caries detector dye) where the dentine is deminera-lized, but the collagen is intact and minimally infected (often referred to as the caries affe-cted zone) (Fusayama 1972) Traditionally, during cavity preparation all caries remains were eliminated (Black GV 1908). Contem-porary cavity preparation, on the other hand, clears caries from the cavity's periphery while merely removing the outside caries infected zone pulpally. Dentists have accepted and practised this type of treatment for years. However, such a restorative technique has a lot of negative implications.

1. **Entry to the restorative cycle:** While caries treatment and restoration provide a short-term advantage of eliminating diseased, soft demineralized dentine and restoring tooth shape, they cannot be considered a long-term remedy because the vast majority of restorations placed by dentists are replacement restorations (Elderton 1990) Individual teeth are frequently re-restored due to restorative material failure, new caries next to the restoration, and tooth structure failure due to weakening.
2. **RDT (remaining dentine thickness) reduction:** When a cavity is prepared and a restoration is placed, the cavity size increases ,and the RDT (remaining dentine thickness) between the cavity floor and the pulp decreases. The RDT has been demonstrated to be the most important variable in cavity preparation that affects pulpal health (Murray 2003)[4].

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3. **Pulpal exposure:** At its most extreme, caries removal in dentine lesions can lead to exposure of vital pulp tissue. Such exposures in symptomless teeth have traditionally been treated with a direct pulp capping or a pulpotomy. When these procedures are employed to treat pulps exposed by dental trauma, they have a high success rate (Cvek 1978). However, outcomes are poor following carious exposures (where the pulp is more likely to be damaged due to diseased dentine) (Al Hiyasat 2006[5] ; Barthel 2000).

In an effort to address and limit the negative repercussions of restorative treatment, more conservative procedures known as minimal intervention strategies for caries control have been established and are becoming more frequently recognised. Minimal intervention can be defined in a variety of ways, although it typically entails total caries eradication. It is uncertain whether the traditional approach to caries removal is necessary and this dogma has been challenged by a number of procedures and studies (Kidd 2004)[6] where partial or no caries removal was carried out (Thompson 2008)[7].

Discussion

Dental caries is the name of the disease and the carious lesion is the consequence and manifestation of the disease.

Caries Management and Carious Lesion Management

Caries management is a term to describe the actions taken at a patient level, that includes

1. Plaque control
2. Tooth brushing instruction,
3. Fluoride application,
4. Dietary interventions
5. Behavior change techniques

Carious lesion management means any procedure that involves doing something to an established, non cleansable carious lesion to stop its progression. This might involve removing *none, some, or all of the carious tissues* from a non cleansable lesion.

Guiding Principles of Caries Tissue Removal

1. Preservation of dental tissues
2. Maintenance of pulpal health
3. Avoidance of pulp exposure
4. Avoidance of dental anxiety (often considered particularly important in children but should be considered for all patients)
5. Provision of sound cavity margins to achieve a peripheral seal

Definitions for Different Clinical Presentations of Dentine: Soft, Leathery, Firm, and Hard (Fig:1)

Soft Dentine: When a hard instrument is forced against it, soft dentine deforms and can be easily scooped up (e.g., with a sharp hand excavator) with minimal force.

Leathery Dentine: Despite the fact that it does not deform when an instrument is put on it, leathery dentine can be easily lifted with little effort. Leathery and firm dentine may have minimal difference, with leathery occupying a middle ground between soft and hard dentine.

Firm Dentine: Firm dentine is physically resistant to hand excavation, and it must be lifted with the use of an instrument.

Hard Dentine: To engage hard dentine, a pushing force with a hard instrument is required, and only a sharp cutting edge or a bur will be able to lift it. When a straight probe is passed across the dentine, a scratchy sound called "cri dentinaire" can be heard.

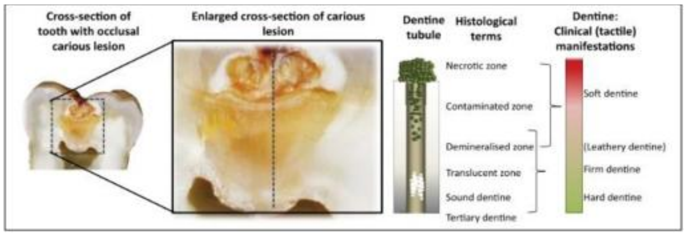

Fig 1: Diagrammatic representation of the carious lesion (after Ogawa et al. 1983)

Different Approaches For Carious Tissue Removal

1. Complete excavation or complete caries removal, also known as non selective removal of hard dentine, is no longer suggested as a method for removing carious tissue. It is a method of removing carious tissue that was once regarded acceptable but is now considered overtreatment. The goal was to remove soft carious tissue in order to reach hard dentine that looked and felt like healthy dentine in all areas of the cavity, including the pulp. Complete caries excavation in the pulpal area is defined by Bjrndal et al. (2010)[8] as "leaving only central yellowish or greyish firm dentin (equivalent to the hardness of sound dentin, as judged by mild probing)". However, for deep caries lesions (reaching into the inner pulpal third of dentine on radiograph), Complete caries excavation, on the other hand, is now thought to be likely to result in tooth detriment through pulp exposure specifically, indirect pulp damage from irritation passing through the thin, remaining dentine thickness or from unnecessarily weakening the tooth's structural integrity (Rickett 2013) [9]. This method isn't advised any longer.
2. Stepwise Removal: Stepwise caries removal includes removal of carious lesion in two stages:

a. Stage 1: Selective removal to soft dentine. Stage 1 has the same carious tissue removal goals as selective removal to soft dentine, but with enough carious tooth tissue removed to construct a durable restoration while avoiding pulp exposure. The cavity's periphery should be firm, resembling sound dentine in appearance and feel. A temporary restoration is put with a restorative material that can last up to 12 months.

b. Stage 2: *6 to 12 months later*, selective dentine removal. The stage 2 pathway involves selective removal to firm dentine with placement of a definitive restoration aimed for permanence, should be pursued after the removal of this interim restoration. 2-step excavation is the name given to this method.

3. Selective Removal of Carious Tissue: Different excavation criteria are utilised when examining the cavity's periphery to the area in close proximity to the pulp in selective removal. To ensure the optimum adhesive seal, the cavity's periphery should be encircled by "sound" enamel. When scraping the surface with a sharp hand excavator or dental probe, the peripheral dentine should be firm and have similar tactile characteristics to sound dentine, such as a scratching sounds.

a. Selective removal to soft dentine: In deep lesions, selective removal of soft dentine means that soft carious dentine is left in the pulpal aspect of the cavity. To get the finest adhesive seal, peripheral enamel and dentine should be firm at the end of excavation. Partial caries, 1-step, ultraconservative, or incomplete caries eradication are all terms used to describe this procedure. Check the softness/hardness of the remaining dentine with a sharp hand excavator; keep in mind that soft dentine will deform when an instrument is pushed against it, and lifting it will need little power. It should be used for deep carious lesions that extend beyond the inner (pulpal) third or quarter of the dentine radiographically; the major goal is to avoid exposing or irritating the pulp, as long as no clinical indications of pulp inflammation are present.

b. Selective removal to firm dentine. In selective removal to firm dentine, the goal is to excavate the pulpal aspect of the cavity to leathery or firm dentine (physically resistive to the hand excavator). In this method contaminated carious lesion but not the demineralized dentine, which can be remineralized is aimed at being removed. It is acknowledged that there are no simple or frequently utilised methods for determining when contaminated tissue has been removed and when what is visible in the cavity is just demineralized dentine. However, the tactile sensation of hitting firm dentine on the pulpal floor, rather than aiming for hard dentine, is probably the best guide that can be offered, despite being somewhat subjective.

4. No Removal: No Dentine Carious Tissue Removal: There are a number of techniques that do not require the removal of dentine carious tissue. Despite the fact that different approaches are employed to do this, the goal is the same: to control the carious lesion without removing any of the damaged dentine tissue. Under the heading of "no carious tissue removal," the following treatments have been included.

a. Sealant materials made of resin or glass ionomer. Over enamel and dentine carious lesions, therapeutic sealant materials (resin or high viscosity glass ionomer cements) can be used. Mechanical qualities are limited for filling and covering microcavities in enamel, especially with unfilled resin.The ability of the materials to resist stresses occlusally when there is a significant quantity of soft dentine beneath the weaker enamel (the "trampoline" effect) is also a theoretical problem. As a result, the scope of lesions where these materials can be used may be limited, pending evidence, to lesions that are confined (on a radiograph) to the outside third of the dentine.

b. The Hall technique :This is a technique for primary molars that involves the placement of a prefabricated stainless steel crown on the tooth to seal dentine carious lesions. The crown is bonded over a primary molar tooth and carious lesion with glass ionomer cement, with no tooth preparation or carious lesion removal. Approximal lesions are the most common indications. The crown efficiently seals the dentine carious lesion and slows or stops it from progressing to the dental pulp, allowing the primary molar to exfoliate without pain and infection.

c. Nonrestorative cavity control: By successfully initiating an intensive preventive programme that involves plaque removal via tooth brushing with fluoridated toothpaste and/or application of fluoride varnish, a cleansable cavity can be achieved. In the case of a carious lesion, it may be necessary to change the shape of the cavity by opening the cavity edges in order to make it cleanable, which would necessitate some operative, but not restorative, intervention. These techniques are most commonly used on primary teeth, but they can also be useful in the permanent dentition, such as in root caries.

d. Application of SDF: It is a safe and effective non restorative treatment option available that aids in caries arrest.

How the intervention might work (stepwise excavation, partial caries removal and no caries removal)

Sealing diseased demineralised dentine into a cavity with a repair that produces a good peripheral seal deprives bacteria of a source of food. The quantity of bacteria decreases, and the caries process halts (Handelman 1976). Not only does the number of bacteria decrease, but the microbial variety also decreases. Only microorganisms that can break down the fluid glycoproteins in pulpal tissue can survive (Paddick 2005)[10] . A number of other clinical trials, such as those reported by Fejerskov[11] and Kidd (2008) and Thompson (2008[7] , have looked into and supported this notion.

Within sealed carious dentine, a gradual drop in the number of organisms and a shift to a less cariogenic microflora leads to a steady reduction in lesion activity and therefore lesion progression. This gives the pulp-dentine complex enough time to lay down tertiary and peritubular dentine, resulting in tubular sclerosis and lowering the permeability of the remaining dentine.

This decrease in pulpal exudate depletes the bacteria's nutritional source even more.

The provisional restoration is removed after a period of time in stepwise caries excavation to allow for additional caries eradication. The tertiary dentine, which has already had time to form, protects the dental pulp even more and minimises the chance of pulpal exposure. Managing carious pulpal exposures using a direct pulp capping approach is associated with a poor prognosis for keeping a vital pulp (AlHiyasat 2006[5]; Barthel 2000), so avoiding pulp exposure is crucial to the tooth's long-term success. Partial caries or no dentinal caries removal techniques also have the potential to reduce cavity size and hence preserve tooth structure. The restoration, however does not have a solid base as a result of such procedures. The long-term influence of this on restoration longevity is still being discussed, albeit it may not be as significant for primary teeth due to their short lifespans.

Important Systematic Reviews Comparing Different Caries Excavation Techniques

Thompson V, Craig RG, Curro FA, Green WS, Ship JA in 2008 [7] did a systematic review on Treatment of Deep carious lesion by complete excavation or partial removal. A search of five internet databases for research on partial versus complete excision of carious lesions generated 1,059 results, of which the authors determined 23 to be relevant. Out of 23, three were randomised controlled trials, one of which followed patients for ten years, give solid support for the wisdom of leaving infected dentin in place, as removing it would expose the pulp. Several other investigations have shown that after cariogenic bacteria are removed from their source of nutrition by restoring adequate integrity, they either die or become dormant, posing no damage to the dentition's health. Hence it was concluded that removing all vestiges of infected dentin from lesions approaching the pulp is not required for caries management.

Ferreira JM, Pinheiro SL, Sampaio FC, de Menezes VA in 2012 [12] did a systematic review on Caries removal in primary teeth. Abstracts of English-language papers published between 2000 and 2010, as well as randomised clinical trials addressing the total, partial, and or nonmechanical removal of carious tissue in primary teeth, were searched in the Medline, Cochrane, and PubMed databases. After reading the abstracts of 151 articles,6 references were chosen for further investigation and out of them 3 papers were identified as potentially relevant to this study. After analysis it was suggested that minimally invasive procedures for dental tissue are viable choices for stopping caries lesions. Partial or non mechanical removal of carious tissue favors the arrest of dental caries lesions. [12]

Aïem E, Joseph C, Garcia A , Smaïl-Faugeron V, Muller-BollaBy M[13] did a systematic review on Caries removal strategies for deep carious lesions in primary teeth in year 2020. Authors conducted a systematic review and meta-analysis of randomised controlled trials, the researchers aimed to compare the efficacy of three caries removal techniques complete caries removal (CCR), selective caries removal (SCR), and stepwise caries removal (SWR) for deep carious lesions in vital temporary teeth (RCTs). Up until May 31, 2019, electronic databases (PubMed MEDLINE, Cochrane Library, EMBASE) were searched for related references. Pulp exposure, pulpo-periodontal problems, and restorative failures are all possible outcomes were assesed. In comparison to CCR, there was a lower risk of pulp exposure after SCR (OR: 0.10, 95 percent CI [0.04, 0.25]) or SWR (OR: 0.20, 95 percent CI [0.09, 0.44]). In an intention to treat analysis, there was a greater probability of composite restorative failure following SCR compared to CCR (OR: 2.61, 95 percent CI [1.05, 6.49]). When comparing SCR to CCR or SWR, the risk of clinical or radiographic pulpoperiodontal complications failure remained unchanged. Hence it was concluded that SCR and SWR may have a lower risk of pulp exposure than CCR. To choose amongst these three caries removal procedures for deep carious lesions in vital temporary teeth, RCTs with lower risk of bias, higher power, and longer follow-up are necessary.

Conclusion

The old principal of GV Black of extension for prevention is long forgotten and modified. Modern operative dentistry is not just limited to drilling and filling. The continuous advancements in researches and materials have made minimally invasive treatment of carious teeth practically attainable. Due to the risk of pulpal exposure, complete caries removal (CCR) and stepwise caries removal (SWR) are no longer indicated in primary teeth. When compared to CCR and SWR, several systematic reviews have found that selective caries removal (SCR) has a similar outcome in terms of clinical and radiographic pulpo-periodontal problems, although there is a much lower chance of pulp exposure. Further RCTs with higher power are still needed to demonstrate conclusively the routine suitability of SCR which is already recommended in the permanent teeth. [13]

References

1. Kidd EAM, Smith BGN, Pickard HM. Pickard's Manual of Operative Dentistry. 7th Edition. Oxford: Oxford University Press, 1998.
2. Fusayama T, Terashima S. Differentiation of two layers of carious dentin by staining. Journal of Dental Research 1972;51(3):866.
3. Elderton RJ. Clinical studies concerning rerestoration of teeth. Advances in Dental Research 1990;4:49.
4. Murray PE, Smith AJ, Windsor LJ, Mjör IA. Remaining dentine thickness and human pulp responses. International Endodontic Journal 2003;36(1):33 43.
5. Al Hiyasat AS, Barrieshi Nusair KM, Al Omari MA. The radiographic outcomes of direct pulp capping procedures performed by dental students: a retrospective study. Journal of the American Dental Association 2006;137(12):1699 705.
6. Kidd EA. How 'clean' must a cavity be before restoration?. Caries Research 2004;38(3):305 13.
7. Thompson VP, Craig RG, Curro FA, Green WS, Ship JA. Treatment of deep carious lesions by complete excavation or partial removal: a critical review. Journal of the American Dental Association 2008;139 (6):70512.
8. Bjørndal L, Reit C, Bruun G, Markvart M, Kjældgaard M, Näsman P, Thordrup M, Dige I, Nyvad B, Fransson H, et al. 2010. Treatment of deep caries lesions in adults: randomized clinical trials comparing stepwise vs. direct complete excavation, and direct pulp capping vs. partial pulpotomy. Eur J Oral Sci. 118(3):290–297.
9. Ricketts D, Lamont T, Innes NP, Kidd E, Clarkson JE. 2013. Operative caries management in adults and children. Cochrane Database Syst Rev. 3:CD003808.
10. Paddick JS, Brailsford SR, Kidd EA, Beighton D. 2005. Phenotypic and genotypic selection of microbiota surviving under dental restorations. Appl Environ Microbiol. 71 (5): 2467–2472.
11. Fejerskov O, Larsen MJ. 2015. Demineralization and remineralisation: the key to understanding clinical manifestations of dental caries. In: Fejerskov O, Nyvad B, Kidd E, editors. Dental caries: the disease and its clinical management. 3rd ed. Oxford (UK): Wiley Blackwell. p. 160–169. 14
12. Ferreira JM, Pinheiro SL, Sampaio FC, de Menezes VA. 2012. Caries removal in primary teeth: a systematic review. Quintessence Int. 43 (1): e9–e15.
13. Aïem E, Joseph C, Garcia A, Smaïl-Faugeron V, Muller-Bolla M. Caries removal strategies for deep carious lesions in primary teeth: Systematic review. Int J Paediatr Dent. 2020 Jul; 30 (4): 392-404.

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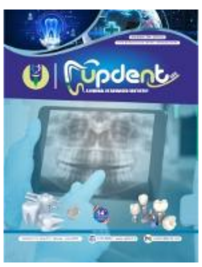

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Crafting Smiles, Serving Souls: DJ Dental News Reports On Prosthodontics Day 2026



Department of Prosthodontics, DJ College of Dental Science & Research, Modinagar (U.P.)
22nd January 2026

Prosthodontic Day was celebrated with great enthusiasm and zeal in the Department of Prosthodontics, DJ College of Dental Science & Research, Modinagar. The occasion was marked by a series of academic, cultural, and community-oriented activities, with active participation from under-graduate and postgraduate students.

The programme commenced with the ceremonial lamp lighting, followed by a fun-filled Dental Quiz that encouraged interactive learning. The vibrant participation of undergraduate students in soap carving, poster presentation and fireless cooking competitions added a lively and creative dimension to the celebration.

As part of the department's commitment to community service, a Free Dental Camp was organised, providing essential oral healthcare services to elderly patients. Additionally, undergraduate students presented a Nukkad Natak, effectively highlighting the importance of replacing missing teeth and educating the public on post-insertion instructions and maintenance of removable prostheses.

The celebrations concluded with a cake-cutting ceremony, after which refreshments were distributed to the patients and participants.

Overall, the event successfully reflected the department's dedication to academic excellence, professional ethics, community outreach, and social responsibility.

Happy Prosthodontist Day

From Playground to Prognosis: Empowering School Teachers in Emergency Anterior Tooth Trauma Management

Traumatic injuries to the front teeth are a common occurrence among school-going children, often resulting from falls, sports activities, or playground accidents. In many such situations, school teachers are the first adults to attend to the child. Understanding this crucial role, the Department of Pediatric and Preventive Dentistry, Institute of Dental Studies and Technologies (IDST), Modinagar conducted a hands-on outreach workshop focused on the emergency management of anterior tooth trauma for school teachers.

The event commenced with an interactive educational session highlighting the epidemiology, classification, and consequences of anterior tooth trauma. Teachers were educated on various storage media for avulsed teeth, including milk, saline, and specialized storage solutions, and were instructed on appropriate methods of storing the tooth without scrubbing the root surface, maintaining moisture, and ensuring prompt transport to a dental facility.

This was followed by a comprehensive hands-on training module where participants were taught to differentiate between primary and permanent teeth, understand indications and contraindications for replantation, and learn correct techniques for handling, replanting, and temporarily stabilizing avulsed permanent teeth. Demonstrations using dental models allowed teachers to practice emergency procedures in simulated scenarios.

A key component of the program was practical training. Participants were taught how to identify whether an avulsed tooth belonged to the primary or permanent dentition and were guided on the appropriate action for each. Demonstrations using tooth models helped teachers understand the correct way to handle an avulsed tooth, avoid damage to the root surface, and maintain moisture. Information regarding suitable storage media such as milk and saline was shared, along with clear instructions on safe storage and quick transport to a dental facility.

To support the school in handling dental emergencies, an emergency dental trauma management kit was handed over. The kit contained sterile gauze, normal saline, small containers for preserving avulsed or fractured teeth, orthodontic wax for stabilizing mobile teeth, clove oil for temporary relief from pain, and a simple instruction booklet. QR codes included in the kit provided instant access to emergency management videos, the Tooth SOS application, and contact details of nearby dental professionals. Following the hands-on training and assessment of participants' understanding, certificates of participation were distributed to all attending teachers.

The workshop concluded with an open discussion, during which teachers expressed increased confidence in managing dental emergencies. This outreach activity reflected IDST's continued commitment to preventive care, community engagement, and the promotion of child-centered oral health.

Fig.1 - Emergency Dental Trauma Management Kit Provided to the School As Part of The Outreach Program.

Fig.2 - Hands-On Training Demonstrating Replantation of an Avulsed Permanent Tooth Into the Socket by a School Teacher Under Guidance.

Fig.3 - Interactive Knowledge-Sharing Session with School Teachers During A Powerpoint -Assisted Lecture and Open Discussion.

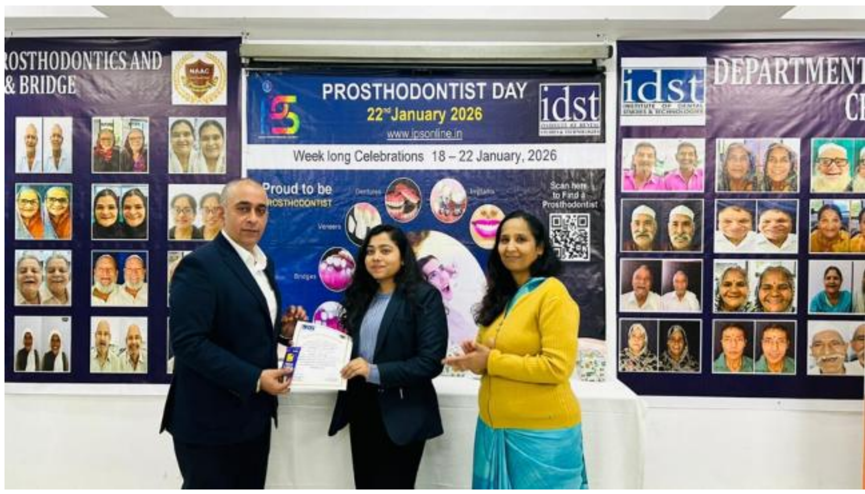
RESTORING SMILES, TRANSFORMING LIVES

IDST MODINAGAR MARKS WORLD PROSTHODONTIST DAY WITH IMPACTFUL WEEK-LONG CELEBRATIONS

The Department of Prosthodontics at IDST, Modinagar, conducted week long celebrations to commemorate World Prosthodontist Day (22nd January, 2026) under the able leadership and guidance of Dr. Vikram Gandhi, Secretary DMET.

The Department headed by Dr. Gaurav Issar organized a series of impactful events and activities.

1. As a part of patient outreach program, dental camps were organized at various locations in Modinagar. Wherein various treatment options for missing teeth and oral hygiene instructions were discussed with elderly patients and their caretakers along with detailed demonstrations on proper denture care and maintenance. This educational initiative was crucial for ensuring that elderly patients understand how to keep their dentures clean, thereby maintaining optimal oral health.
2. The department carried out implant placements and rehabilitation of 20 implant cases, free of cost, for needy patients of Modinagar.
3. Also, a week long denture camp was organized wherein 50 dentures were carefully crafted within the week and distributed to elderly patients along with denture boxes, denture brushes, snacks and complimentary sweets. This gesture was aimed at not only restoring the patients' smiles but also contributing to their overall well-being.
4. A guest lecture on burs and their management was



also conducted for post graduates and interns by Dr. Sukriti an eminent prosthodontist.

5. Post Graduates of the Department made videos on post prosthesis delivery instructions which were shown and shared with all the patients.
6. The celebrations included engaging student activities such as Soap Carving, Best Out of Waste, and Painting Competition. The under graduate & post graduate students participated enthusiastically, showcasing their creativity and skills.

Winners from both undergraduate and postgraduate categories were awarded at a special ceremony held on January 23rd, which was attended by key dignitaries, including Dr. Vikram Gandhi, Secretary DMET, Mrs. Anisha Gandhi Member Trustee DMET, Principal Dr. Nidhi Agarwal, Vice Principal Dr. Achint Juneja, Director PG Studies, Dr. Gaurav Mittal and Heads of various Departments. The day culminated with a cake-cutting ceremony to mark the occasion and celebrate the contributions of prosthodontists to the field of dentistry.

The celebrations were a resounding success, highlighting the department's commitment to community welfare, student engagement, and patient care. Special thanks were extended to Mrs. Asha Gandhi Chairperson DMET, Dr. Vikram Gandhi Secretary DMET and Mrs. Anisha Gandhi for their continued guidance and support, which made the event a memorable success.

WHEN YOU EDUCATE A GIRL, YOU EDUCATE A NATION

My journey to becoming a Prosthodontist-a specialist in the art and science of restoring smiles-has been a challenging yet incredibly rewarding path. But the degrees on my wall and the fulfilling work I do each day are not mine alone. They are a reflection of the unwavering support, sacrifices, and belief of the family who nurtured my dreams and the husband who became my partner in purpose. A path filled with long hours, rigorous study, and immense dedication, was never one I walked alone, they belong equally to the unwavering pillars of my family who believed in gender equality.

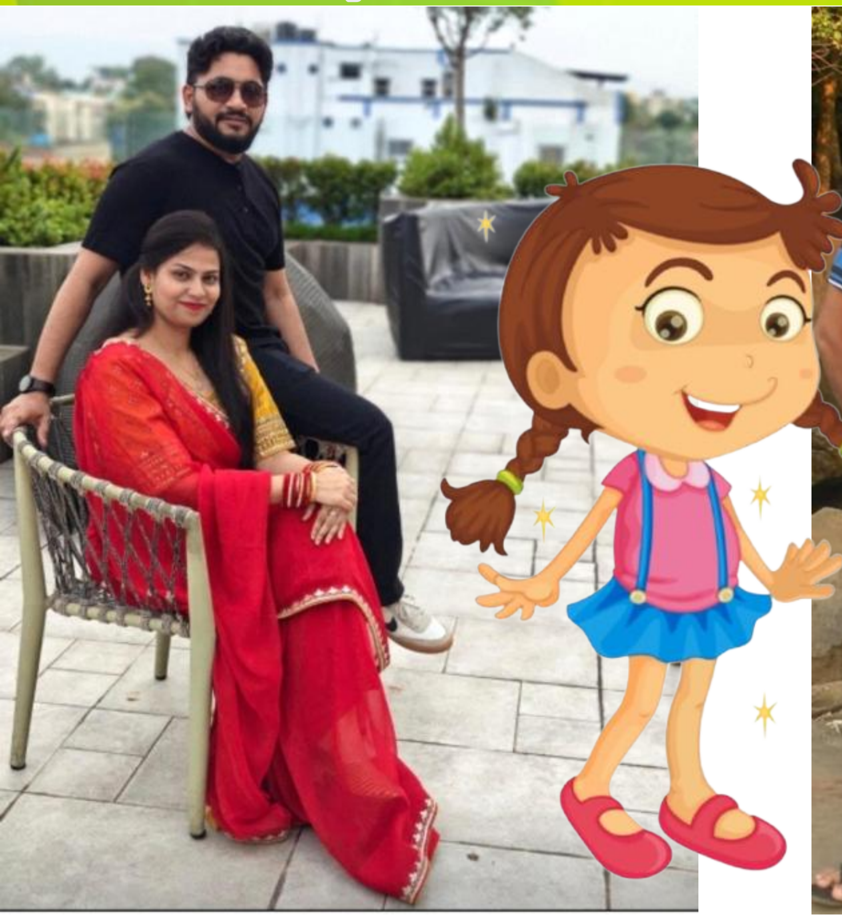
Growing up, I was fortunate to be born into a family where education for a girl was not a question, but a given . In a society where many young girls are still discouraged from pursuing higher education or ambitious careers, my Mother **Mrs Safina Rahmat** and Father **Mr Mohammed Hassan Khan** were my first and most profound champions. They saw my potential, not my gender.

My mothers love for education cannot be summed up in mere words, She put in her heart and soul in educating her three daughters and son. My parents invested their resources, time, and emotional energy into ensuring I had every opportunity to succeed. This early foundation of belief-that as a girl, I had a right to dream big-was the single most important factor in my journey. Long before the late nights in the lab and the high-stakes exams, my family planted the seeds of my ambition. They instilled in me the value of hard work and compassion, principles that are at the core of my practice today. They were my first teachers, showing me that empathy is as vital as expertise in caring for people.

In life, I am blessed to find a partner ,my husband **Dr Shaikh Abdus Salam** who is an epitome of how to value ,respect and love ones wife. Its after my marriage that I pursued my M.D.S in Prosthodontics and write from writing NEET entrance to completing my degree till this date when I am an Assistant Professor my husband has equally taken up all whether emotional or financial burden. Himself a critical care specialist , never viewed my career as a competitor to our life together, but as an essential part of my identity.

His support was not just passive; it was an active, day-to-day partnership .He celebrated every small victory and offered a steady hand during every setback. I remember one particularly challenging week of my residency when I felt completely shattered. I came home late, exhausted, and questioning my own capabilities. Instead of dismissing my concerns, he simply listened, letting me vent without judgment. He made sure I was nourished, both physically and emotionally.

His belief in me, even when my own faltered, was the anchor that kept me grounded. He understands that my profession is not just a job but a calling, and he has always honoured and supported that passion In his support, I found the space to grow, to innovate, and to become the best



version of myself, both at home and in my practice.

My sisters **Ayesha Hassan, Sarah Hassan,** my brother **Mohammed Tauseef Hassan Khan** and his wife **Farnila Usmani** were and will always be a part of my success and pillar of strength as they are the ones whose eyes glitter and jump with joy on all my achievements.

I am extremely blessed to have most awesome father in law **Mr Shaikh Abdul Alim** and mother in law **Mrs Shehnaz Bano** who always support me to pursue my dreams and celebrate each stepping stone to success. Each girl child should be allowed to pursue what she wants irrespective of before or after marriage.

I hope this story of mine sets an example as educating and empowering girls leads to stronger, healthier, and more peaceful communities. An educated girl can uplift her family and future generations.

I strongly believe women offer unique insights and approaches that can lead to innovative solutions in all areas, from technology to governance.

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INNOVATION, EDUCATION, AND EXCELLENCE: COLTENE INDIA'S VISION FOR THE NEXT ERA OF DENTISTRY

WHERE SWISS PRECISION MEETS INDIAN DENTISTRY: A CONVERSATION WITH THE MANAGING DIRECTOR-MR FARHAT HASAN OF COLTENE INDIA

Could you please brief our readers about your professional journey and your role as Managing Director of Coltene India?

I graduated in Engineering from Dr. Zakir Hussain College of Engineering & Technology in 1996 and later pursued an MBA. My career began with an importer of Heraeus Kulzer lab products as a sales and service engineer. Later, worked in sales department with Kulzer and Dentsply. Since 2009, I have served COLTENE in multiple roles-area sales manager, regional manager, national sales manager-and since September 2017, I have been the Managing Director of Coltene India covering India for India, Nepal, Bhutan, Sri Lanka, Bangladesh and Maldives markets.

How has Coltene India evolved in the Indian dental market over the years?

COLTENE started direct operation in India in 2009 with its distinctive portfolio of Dental Dams, silicones, composites, bonding agents, and post-and-core materials. While already a respected name in Europe, COLTENE was relatively unknown in India. Our team's strong credibility, customer relations and small but strong product portfolio supported by referrals and continuing dental education, gradually established COLTENE as a trusted brand in the Indian market.

What core values and philosophy guide Coltene's operations and innovations globally and in India?

At COLTENE, we believe that everything considered best can always be made little better and more efficient-we apply this to our products, services and people. Innovation is triggered by users' genuine opinions and hunger for better solutions . HyFlex CM and HyFlex EDM exemplify innovation in metallurgy and manufacturing, respecting canal anatomy while offering several added advantages compared to the conventional popular file systems of that time. Products like Dual Shade composites, Affinis, and Speedex were designed to address long-standing challenges faced by dentists, embedding practical solutions into everyday clinical practice.

Which product categories from Coltene have received the strongest response from Indian dentists, and why?

Our dental dams, HyFlex CM, CanalPro Endomotors, Paracore, Tenax Trans, Paraposts, Brilliant EverGlow, One Coat Bonds, Speedex, and Affinis are not only bestsellers but considered gold standards in their categories. They deliver superior value to customers. Products such as HyFlex EDM and Biosonic Cleaners, though not high-volume, are highly regarded for their uncompromising quality. Our newly launched products-SwissTEC composite Kits, burs and CanalPro Bioceramic Sealer, etc. received tremendous response.

How does Coltene ensure quality, consistency, and clinical reliability in its dental materials and solutions?

Quality, precision, and efficiency are embedded in our DNA as a Swiss company. Our tagline-"*We preserve and improve natural teeth, the Swiss way*"-reflects this commitment. Every product undergoes years of research, testing, and trials before launch, supported by our state-of-the-art "Centre of Excellence" in Altstätten, Switzerland. We continuously engage clinicians to share cases, feedback, and suggestions, ensuring a loop of improvement and reliability.

Innovation is key in dentistry today-how does Coltene stay ahead in research and product development?

Innovation at COLTENE is driven by clinician feedback and market needs, supported by strong R&D and marketing. Our strategic focus is *Endo to Resto (E2R)*, where we aim to be a global leader while remaining niche. COLTENE manufactures one of the widest ranges of dental products worldwide-from cotton rolls to isolation, endo, resto, prostho, and sterilization. Our focus is more on innovation within the focussed segments.

What challenges do you see currently in the Indian dental industry, and how is Coltene addressing them?

India has traditionally relied on imports in niche dental segments, unlike pharma where it is a global leader specially in generic medicines. Recently, locally manufactured "me-too" products have gained traction due to pricing, leading to comparisons across different product classes. Anticipating this, we strengthened our production in India after covid 19. This ensures competitive pricing without compromising the quality. Another challenge is the appreciation of the Swiss Franc against the rupee, nearly 15% higher compared to imports from countries like Japan. While beyond our control, we expect a slow relief through the free trade agreement (TEPA) effective October 2025.

How important is dentist education and training in your overall marketing and brand-building strategy?

Continuous learning is essential-those who don't upgrade risk becoming obsolete. COLTENE is recognized for its contribution to dental education and skill enhancement through multiple platforms, including our unique concept: *UDTC-Upgrade Dentistry Training Centres.*

What role do exhibitions, journals, and professional platforms play in strengthening industry-clinician relationships?

As you know "*Out of sight, out of mind.*" - This makes our participation a necessity.

Exhibitions, trade shows, and journals keep us visible, and additionally foster interaction, and build trust. These platforms strengthen engagement and reinforce long-term relationships with clinicians and our business partners.

Digital marketing is rapidly transforming brand outreach. How does Coltene balance traditional and digital branding strategies in India?

Both strategies complement each other. Traditional marketing sustains personal connections, while digital marketing expands visibility faster and across wider geographies. Together, they ensure balanced brand outreach.

India is a diverse and price-sensitive market. How does Coltene maintain premium quality while remaining accessible to Indian practitioners?

We believe customers deserve the best value for their investment. India's market is vast and highly price-sensitive, but economy of scale works to our advantage. Higher volumes at lower margins ensure accessibility. At the same time, there is a segment of practitioners who prioritize premium quality over price, and we cater to them equally. With economic growth, we are confident to add more premium customers in our buyers lists.

What are Coltene India's growth plans and strategic focus areas for the next 3-5 years?

Growth is never by mere chance; it is a result of forces working together- *James C Penney*

With India's market potential still underpenetrated-our reach is less than 10% due to various operational constraints-our strategy is twofold: expand customer reach and deepen engagement with existing clients by offering more products. Strengthening local production will be a cornerstone of our organic growth roadmap.

We have achieved and aim to surpass a sustainable growth by at least by 5% in excess to the nominal GDP Growth in India.

From an industry leader's perspective, what advice would you give to young dentists when choosing dental materials and technologies?

Price is what you pay; value is what you get. Focus on value rather than the prices alone. Success requires both skills (say software) and armamentarium (say hardware). If one is weak, the other cannot deliver optimal results. Continuous upgradation ensures efficiency and sustainable success in the long run. The saying "There are no short cuts to sustainable success"-is still true.

Heal Talk Dental Journal has emerged as a trusted dental media platform in India. What motivated Coltene India to choose Heal Talk for branding and industry communication in the Indian dental market?

Heal Talk showcases numerous clinical cases, fostering peer-to-peer learning. This aligns perfectly with our philosophy of knowledge-sharing and continuous improvement, making it a natural choice for our industry communication.

Precision in Sealing.
Confidence in Healing.
Advanced Root Canal Sealers & MTA Repair Solutions

ENDODONTIC MATERIAL RANGE

ROOT CANAL SEALERS

Kris Bio Active+ – Bio-Ceramic sealer Biological sealing & healing support

2 SYR x 1 GM

Pro Root X+ – Epoxy-based sealer Permanent, long-term sealing

BASE : 6 GM CATALYST : 8.5 GM

Root X- Zinc oxide–based sealer Routine root canal obturation

LIQUID : 8 ML POWDER : 15 GM

ROOT REPAIR & MTA SOLUTIONS

MTA Putty X – Ready-to-use MTA Perforation repair & apical plug formation

2 SYR x 0.7 GMS

MTA Root-X Pro – Advanced repair material , Root-end filling & complex repairs

LIQUID : 2 ML POWDER : 1 GM

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