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Journal of Indian Association of Kochi Branch (JIDAK) is the official scientific publication of Indian Dental Association, Kochi Branch. It is a peer-reviewed journal published triannually in e-format as well as print format.

The journal invites manuscripts from dental and other allied health sciences. It publishes manuscripts under categories of Original Research, Review and Case Reports.

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Editorial Board

PRESIDENT'S MESSAGE

It gives me immense pleasure to present the second issue of JIDAK, the official publication of IDA Kochi. As we continue our journey of academic excellence and clinical insight, this edition brings forth a rich blend of contemporary case reports and thought-provoking reviews.

The spotlight in this issue falls on compelling case reports, including clinical perspectives on odontogenic keratocysts (OKC) and the application of laser-assisted teeth whitening—both reflecting the evolving trends in modern dental practice. We are also privileged to feature an insightful editorial that sheds light on the often-overlooked consequences of faulty restorative treatments.

I congratulate all the contributors and offer immense appreciation to Dr. Pooja Latti and her editorial team for their dedication in upholding the journal's high standards.

I invite our readers to engage deeply with the content and continue contributing to the knowledge-sharing spirit of JIDAK.

Warm regards

Dr. Harigovind B
President, IDA Kochi Branch

SECRETARY'S MESSAGE

It gives me immense pleasure to pen these words to the second issue of 'Journal of the Indian Dental Association, Kochi Branch' for this year—a valuable platform that reflects the collective academic spirit of our dental community.

Academic writing plays a pivotal role in the advancement of dentistry. Through evidence-based articles, case reports, reviews, and clinical studies, we not only document our scientific progress but also contribute to shaping the standards of care, policy-making, and public health initiatives. It is through diligent research and structured scientific communication that we can challenge outdated practices, embrace innovation, and ensure the continual growth of our profession.

I congratulate all contributors, reviewers and the editorial team who are dedicated to upholding the quality and integrity of this journal. Your efforts ensure that knowledge flows freely among practitioners, educators, and students, inspiring clinical excellence and lifelong learning.

Let us continue to encourage a culture of academic curiosity and integrity. By actively participating in scholarly writing, we not only strengthen our individual practices but also empower the future of Indian dentistry.

Warm regards,

Dr. Vivek Narayan
Hon. Secretary, IDA Kochi Branch

CHIEF EDITOR'S MESSAGE

Dear Readers,

With immense gratitude and pride, we present the second issue of the Journal of Indian Dental Association, Kochi Branch, May-July 2025. As we continue to grow as a platform for knowledge dissemination, professional development, and collaborative learning, this issue reflects the vibrant academic and clinical spirit of our dental fraternity.

The month of May brings to the forefront several key health observances — World No Tobacco Day on May 31st being a particularly relevant one for dental professionals. It serves as a reminder of our pivotal role in tobacco cessation advocacy and early detection of oral precancerous lesions, especially among vulnerable populations.

In this issue, we are pleased to feature a blend of clinical case reports and insightful reviews, each contributing to the collective pursuit of evidence-based dentistry. The editorial team has strived to maintain rigorous standards in selecting content that is both relevant and practical for clinicians, academicians, and students alike.

As we witness rapid advancements in digital dentistry, artificial intelligence, and biomaterials, it is imperative that our community stays updated and actively contributes to the evolving body of dental knowledge. This journal, we hope, becomes not just a publication but a platform for dialogue, discovery, and development.

A heartfelt thank you to our contributors, reviewers, and editorial board members for their tireless efforts. We also encourage our readers to consider submitting their work for future issues — your experience and insights could shape the practice of many.

Let us continue to learn, lead, and inspire.

Dr. Pooja Latti
Chief Editor, JIDAK

CONTENTS

1. **IATROGENIC RESTORATIVE CARIES (IRC): A NEGLECTED SEQUELA OF FAULTY RESTORATIVE DESIGN**
Dr. Jojo Kottoor 10-15

2. **FROM WASTE TO RESOURCE: APPLYING CIRCULAR ECONOMY IN DENTAL SUSTAINABILITY**
Dr. Sudeep C B, Dr. Chaitra Thaliyil 16-20

3. **NEEDLELESS ANESTHESIA: CHANGING THE LANDSCAPE OF CONVENTIONAL ANESTHETIC TECHNIQUES**
M S Anirudh, Ruby Raihan M, Sarath Mohan M S
Sandra T Sunil, Dr. Subramaniam R, Dr. Priya Babu
Dr. Jesline Merly James 21-25

4. **ODONTOGENIC KERATOCYST: A CASE REPORT AND CLINICAL INSIGHTS**
Dr. Surya Suprabhan, Dr. Ashna P A, Dr. Alto Franc
Dr. Anu P Damodaran, Dr. Sajana U S 26-31

5. **TELEDENTISTRY: REVOLUTIONIZING DENTAL CARE THROUGH TECHNOLOGY**
Farsana T N, Fathima Zuhra E
Evina Antony, Farsana Sagar, Aliya Nazeer
Dr. Pooja Latti, Dr. Sharon Philip 32-40

6. **A BRIGHTER SMILE: SUCCESSFUL LASER TEETH WHITENING – A CASE REPORT**
Dr. Reshma T S, Dr. Anita Benny 41-44

EDITORIAL

IATROGENIC RESTORATIVE CARIES (IRC): A NEGLECTED SEQUELA OF FAULTY RESTORATIVE DESIGN

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In everyday dental practice, Class II caries adjacent to previously restored or prosthetically treated teeth is a common finding. Such lesions are often misdiagnosed as recurrent or unrelated primary decay. However, a closer evaluation frequently reveals that these caries result from design flaws in nearby restorations, particularly improper proximal contact, incorrect contouring, or occlusal discrepancies with opposing teeth. This overlooked etiology warrants recognition as a distinct clinical category, which we propose to term: **Iatrogenic Restorative Caries (IRC).**

Defining IRC and Its Clinical Relevance

Historically, the term *iatrogenic caries* referred to decay initiated due to procedural trauma during cavity preparation, wedge placement, or matrix band application[1,2]. In contrast, **IRC represents a separate pathogenic mechanism**, defined as:

A carious lesion that develops on an otherwise sound natural tooth due to biomechanical or anatomical deficiencies in adjacent or opposing restorations, most commonly involving contact integrity, contour, or occlusal relationships (Figure 1A & B).

These deficiencies create pathological microenvironments characterized by food traps, plaque retention zones, and traumatic occlusal loading, all of which compromise adjacent teeth over time.

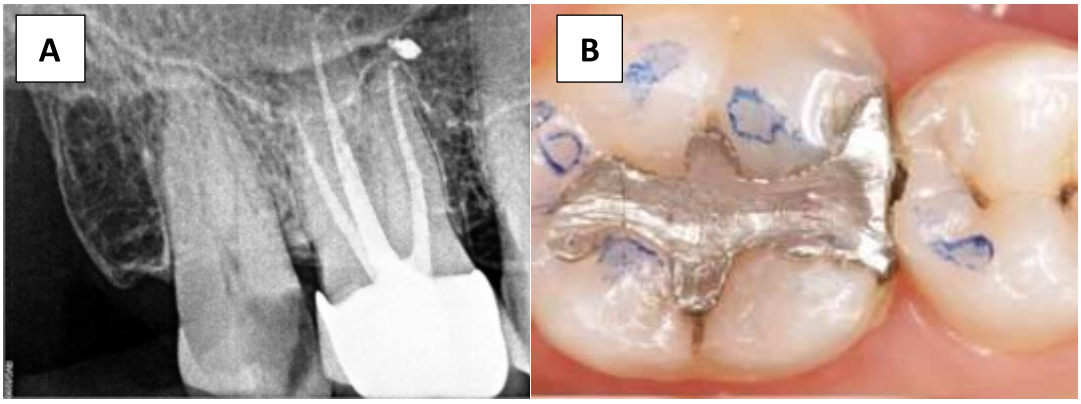

Figure 1. (A) shows a radiograph of teeth #17 and #18, illustrating mesial caries on #18 due to an overhanging and over-contoured crown margin on #17; an example of Iatrogenic Restorative Decay (IRD). (B) demonstrates a mesio-occlusal Class II amalgam restoration on teeth #46 with improper contact and contour, resulting in IRD on the distal surface of tooth #45.

I. Understanding the Functional Triad: Contact, Contour, and Occlusion

A. Proximal Contact: More Than Just "Touch"

Proper interproximal contact is essential to prevent food impaction, maintain arch stability, and protect interproximal tissue health[3].

- In anterior teeth, the contact point is located near the incisal third, while in posterior teeth, it is a broader area around the middle third.
- Loss of contact, excessively flat contact, or open contact leads to food lodgement, gingival irritation, and caries formation in the adjacent tooth.

A true contact must be *physiological*, allowing proper occlusal and gingival embrasures for effective plaque control.

Common error: Some clinicians attempt to prevent food impaction by directly bonding adjacent teeth with composite resin (Figure 2A). While well-intentioned, this approach obstructs natural embrasures, creating stagnation zones that are difficult to clean, leading to recurrent caries and gingival inflammation. Similarly, filling the gingival embrasure with composite to block lateral food lodgement (Figure 2B) disrupts the natural anatomic form and promotes plaque accumulation.

Such interventions should be avoided unless absolutely justified.

B. Axial Contour and Emergence Profile: The Self-Cleansing Blueprint

Tooth surfaces are naturally contoured to facilitate self-cleansing by cheeks, tongue, and lips, while also promoting gingival health and ensuring proper restorative material thickness[4].

- **Over-contouring:** Leads to bulky margins, plaque retention, and reduced accessibility for oral hygiene (Figure 3A).
- **Under-contouring:** May cause trauma from food impaction but is easier to maintain hygienically (Figure 3A).

Emergence profile: The transition of a restoration from the sulcus must be smooth and convex to support gingival architecture (Figure 3B). A flat or abrupt profile distorts gingival adaptation, leading to inflammation[5].

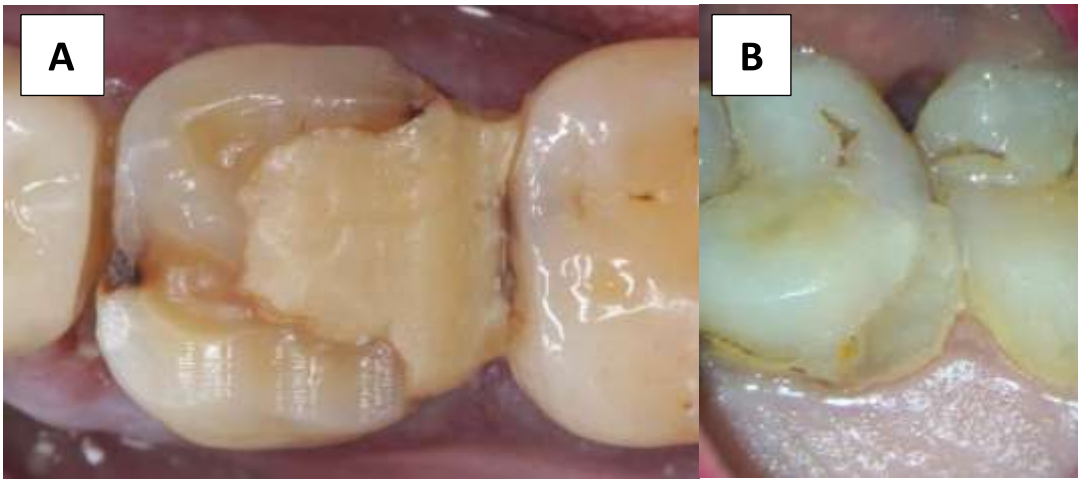

Figure 2. (A) Tooth #45 with a full-coverage crown and tooth #46 (centre) with a distal-occlusal composite restoration extending onto #47. In 1A, the distal restoration of #46 lacks proper occlusal embrasures, impairing the natural self-cleansing mechanism, while the mesial side shows an open contact due to the improper contour of the crown on #45.

In figure (B), food lodgement was addressed by covering the entire gingival embrasure with composite between #46 and #47, a design that disrupts natural anatomic contact and contour, which should be avoided.

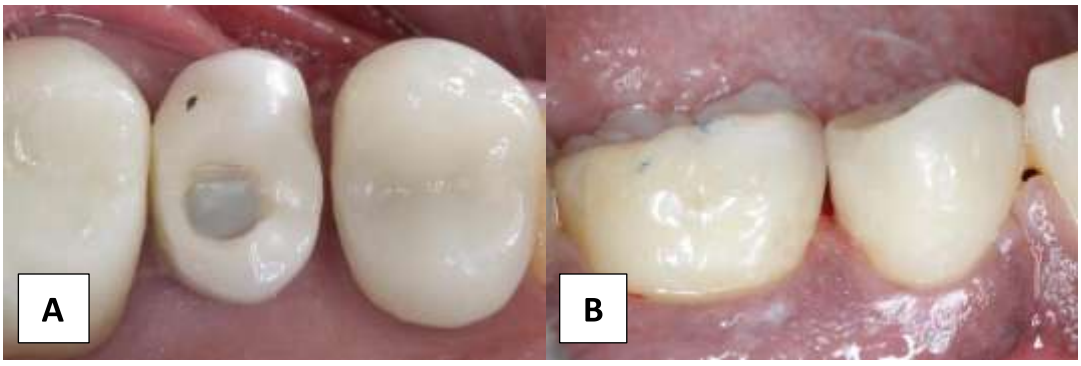

Figure 3. (A) Clinical image showing crowns on teeth #24, #25, and #26, where the crown on #25 is under-contoured and the crowns on #24 and #26 are over-contoured, resulting in a lack of harmony with the natural anatomical contour.

(B) Restored #46 mesial and #45 distal surfaces demonstrating a smooth, convex emergence profile from the sulcus, ensuring proper support of the gingival architecture and creating natural aesthetic harmony.

Clinical note: In indirect restorations, over-contouring typically arises from inadequate tooth preparation, where excessive preservation of enamel results in restorations that extend beyond the natural tooth contours. Additional contributing factors include the clinician's and technician's limited understanding of proper tooth morphology in both direct and indirect restorations.

C. Occlusion: The Silent Influencer

Restorations must respect centric stops, avoid interferences, and distribute forces evenly.

Tooth Movement and Super-eruption: A Delayed Consequence of Occlusal Disharmony

Unbalanced occlusion can indirectly cause iatrogenic contact failure through tooth migration. When a restoration fails to replicate proper occlusal contacts, unopposed teeth may undergo **super-eruption** or adaptive movement in an attempt to re-establish functional contact.

These gradual changes occurring over weeks or months and can disrupt previously stable interproximal contacts, creating new stagnation zones that predispose to food impaction, caries, or restoration failure.

Clinical note: Occlusal evaluation should consider not only static contacts but also potential tooth movement over time, especially in cases involving single crowns, tilted teeth, or missing antagonists.

III. Overhanging Restorations: A Compounding Factor

Overhanging margins are a visible form of iatrogenesis, commonly seen in Class II restorations (Figure 5A) and subgingival crown margins (Figure 1A).

Causes of overhangs include:

- Improper adaptation of the matrix band to the proximal surface, often due to incorrect matrix selection or poor wedge placement.
- Overflow of restorative material at the gingival margin.

Indirect restorations (e.g., crowns) may present overhangs if the technician misreads the gingival finish line or disregards proper emergence profile, leading to gingival invasion and biologic width violation.

Overhanging margins act as **plaque-retentive irritants**, leading to gingival inflammation, bacterial colonization, endotoxin release, periodontal breakdown, and eventual **secondary or iatrogenic restorative decay** on adjacent teeth (Figure 1B).

Clinical note: Even minor overhangs can significantly disrupt the microbial ecology, shifting it toward pathogenic biofilms.

IV. Prevention and Clinical Recommendations

- **Direct Restorations:** Use sectional matrix rings, anatomical matrix bands, and wedges effectively (Figure 4 A-H).

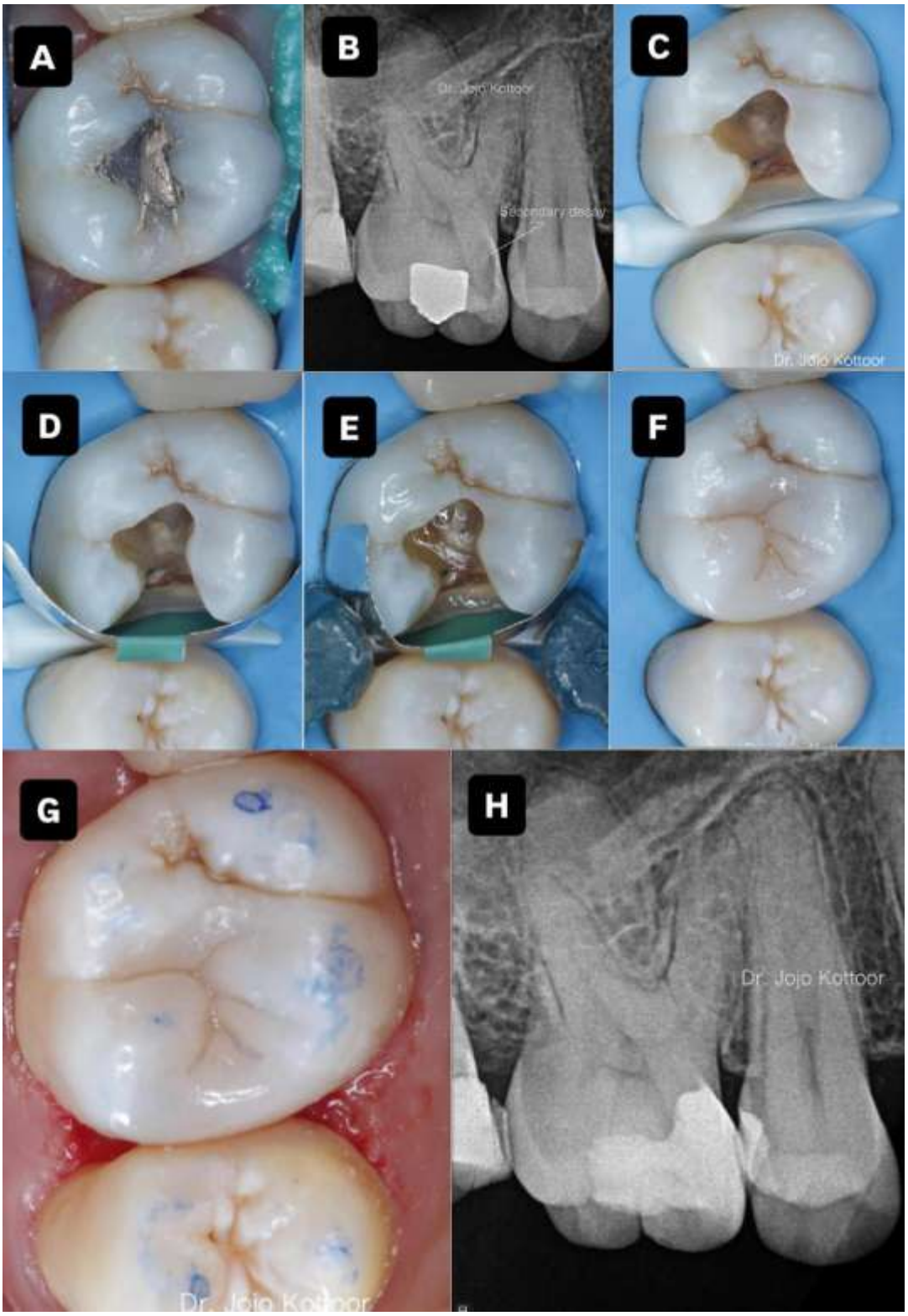

Figure 4. (A) Pre-operative clinical image - Existing restoration with secondary caries; note improper mesial contour of premolar, later corrected for ideal contact. **(B)** Pre-op radiograph showing secondary caries beneath the old restoration. **(C)** Preparation & Wedge - Caries removed; proper wedge placed for gingival seal. **(D)** Matrix Band - Sectional matrix band adapted for precise contour. **(E)** Matrix Ring - Sectional ring placed for optimal contact formation. **(F)** Post-op Restoration - Composite restoration with natural anatomy. **(G)** Occlusal Check - Occlusion verified in centric and eccentric movements. **(H)** Post-operative radiograph confirming proper adaptation and contact.

- **Crowns:** Verify that proximal contacts allow for proper embrasure formation. Watch for overbuilt proximal "dimples" by laboratories (Figure 5 A-D).
- **Adjacent Errors:** Correct mispositioned adjacent contacts with additive or subtractive adjustments (Figure 4 A & G). *Never block embrasures with composite unless they can be re-created anatomically.*

Clinical Implications and Call to Action

Human dentition is a **biological and biomechanical masterpiece**, with 32 individual teeth, each with distinct morphology and function, rather than two generalized horseshoe-shaped structures. This complexity reflects the unique roles of each tooth in mastication, speech, and aesthetics.

From a clinical and ethical standpoint, **restorative dentistry must replicate, not distort, this natural blueprint.** In the era of adhesive and minimally invasive dentistry, success is defined not by simply filling a cavity, but by how well the restoration integrates into the patient's natural biomechanical and biological environment.

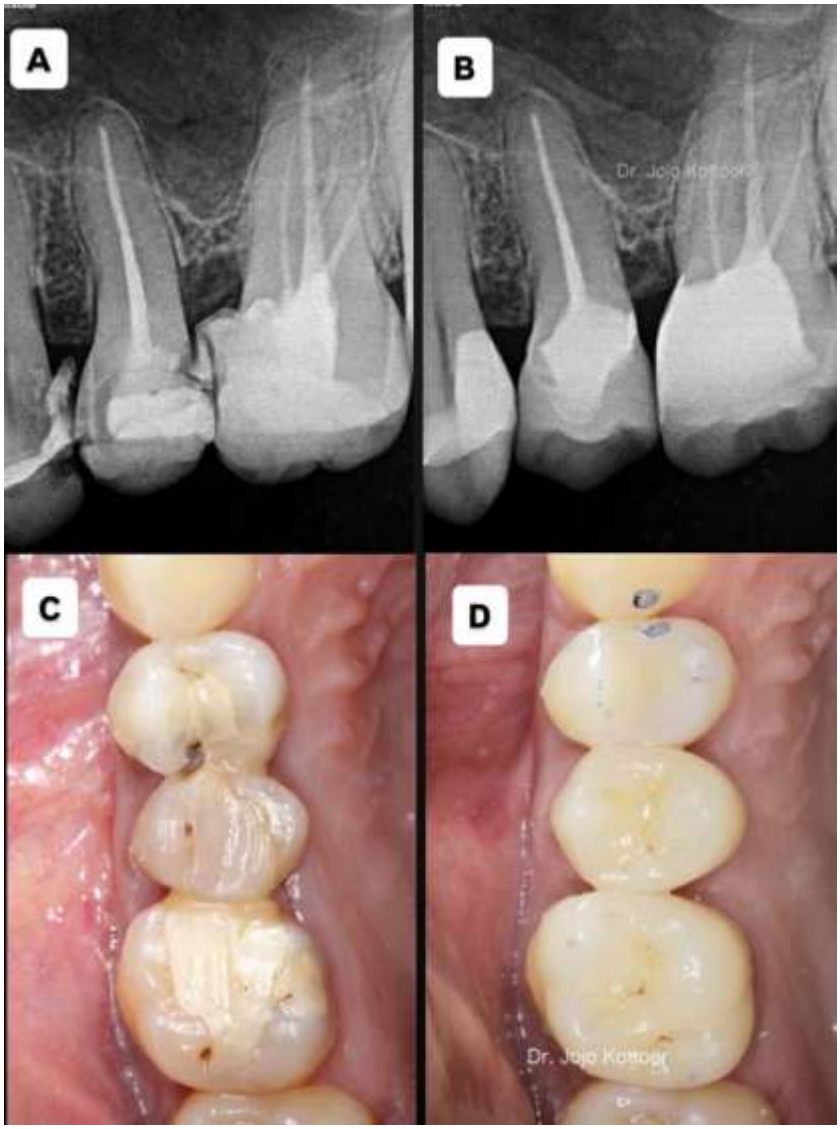

Figure 5. (A) Pre-operative radiograph showing improper restorations on teeth #24, #25, and #26. (B) Post-operative IOPAR after correction with a direct composite on #24, a full-coverage crown on #25, and a tabletop ceramic restoration on #26. (C) Pre-operative clinical image depicting faulty contact and contour. (D) Post-operative clinical image showing ideal contact, contour, and occlusal anatomy recreation.

Clinicians must:

- Respect the anatomical triad of **contact, contour, and occlusion.**
- Avoid "quick fixes" (e.g., bonding teeth together) that create long-term issues.
- Utilize **digital diagnostics, magnification, and evidence-based design** to enhance precision.

It is time to formally recognize **Iatrogenic Restorative Caries (IRC)** in clinical education, diagnostic terminology, and treatment planning for both ethical integrity and long-term functional success.

CONCLUSION

Iatrogenic Restorative Caries **is not a microbial accident; it is a design failure.** Adjacent teeth suffer when restorative anatomy deviates from nature. To safeguard healthy teeth, clinicians must shift from a **repair mindset to a biomimetic preservation approach. Let us evolve from being iatrogenic triggers to biomimetic protectors, because the health of one tooth is deeply tied to the design of its neighbour.**

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REVIEW ARTICLE

FROM WASTE TO RESOURCE: APPLYING CIRCULAR ECONOMY IN DENTAL SUSTAINABILITY

ABSTRACT

Dentistry has traditionally operated on a linear "take-make-dispose" model, generating a complex mixture of biomedical, chemical, digital, and single-use plastic wastes. The circular economy (CE) proposes shifting to a closed-loop, sustainable model emphasizing resource recovery, reuse, and regeneration. This review explores the integration of CE principles into dental practice, analysing current waste streams, feasible interventions, equipment design, and behaviour- and supplier-driven strategies. Barriers including infection control, regulations, and initial costs are critically evaluated. Real-world case studies demonstrate how lean management and CE have been harmonized to reduce waste, carbon footprint, and expenses. We offer actionable recommendations for clinicians, educators, policymakers, and manufacturers to foster greener dentistry and position oral care as a front-runner in eco-responsible healthcare.

Keywords: circular economy, dental waste, sustainability, green dentistry, resource recovery.

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INTRODUCTION

The global healthcare sector accounts for roughly 4-5% of greenhouse gas emissions, with dentistry contributing a noticeable share through consumables, single-use items, and energy-intensive procedures[1,2,3]. Traditional dental practices follow a linear model: extract materials, fabricate products, and dispose of waste. However, emerging environmental pressures demand transformation towards circular, resource-efficient models[1]. The circular economy (CE) disrupts the linear model by emphasizing resource retention through reuse, recycling, and regenerative design[1,2]. In dentistry, CE principles apply to material reuse (e.g., reclaimed gypsum), efficient equipment design, and digital transition (e.g., intraoral scanning vs. alginate impressions)[1,2]. Integrating lean management further augments efficiency by eliminating redundant processes and aligning staff practices with CE goals[1].

Despite this promise, dentistry remains lagging in systematic adoption of CE thinking. Most studies focus narrowly (e.g., amalgam separators, digital radiography) rather than on holistic systems approaches[1,2]. This gap presents both a challenge and an opportunity: to craft interdisciplinary, clinic-wide strategies that address materials, behaviours, supply chains, and regulation.

This article aims to review the current waste landscape in dental clinics, synthesize circular economy and lean management strategies, illustrate implementation via case studies, explore barriers and solutions, and propose a roadmap for embedding CE in clinical dental settings.

2. Current Waste Landscape in Dentistry

Dentistry generates diverse waste streams with distinct environmental and regulatory implications:

2.1 Infectious/Hazardous Waste[1]

Sharps, gauze, gloves contaminated with blood/saliva, amalgam, lead foils, and chemical disinfectants fall under mandated biohazard protocols. Such waste requires careful segregation, decontamination via autoclave or incineration at ≥1,100°C, and tight regulation due to cross-contamination risk.

2.2 Non-Hazardous/Common Waste[2,3]

Paper, plastics, packaging, gypsum casts, intraoral scanners' sleeves fall into non-hazardous municipal waste but still contribute to landfill burdens.

2.3 Chemical and Metal Waste[4,5]

Amalgam (mercury), developer/fixer fluids, disinfectants, and dental metals are components with potential high toxicity if released improperly.

2.4 Digital and Electronic Waste[6]

Digital radiography panels, CAD/CAM milling machines, 3D printers, and intraoral scanners add a novel waste category: electronic waste (e waste), often overlooked in regulations.

2.5 Plastic Waste[2,3]

Disposable PPE, impression trays, chair covers, suction tips plastics account for ~36% of healthcare waste in Europe, with dental clinics reflecting similar proportions.

2.6 Quantitative Impact[7]

A university clinic study reported average waste per dental chair per day as 81.4g aprons, 56.2g gloves, 17.2g masks, and ~24g wrappers. This represents significant daily and annual waste loads, emphasizing the potential impact of segregation and recycling practices.

3. Circular Economy and Lean Management: Conceptual Integration

3.1 Circular Economy Principles[1,4,8]

- Design out waste and pollution by favouring reusable, biodegradable, or recyclable alternatives vs disposables.
- Keep products and materials in use through reuse, refurbishing, and recycling (closing loops).
- Regenerate natural systems by opting for compostable materials and reducing chemical/pollution output.

3.2 Lean Management[1]

Originating from manufacturing, lean emphasizes optimizing workflows to reduce waste

(overproduction, defects, waiting, transport, unnecessary motion, inventory, and unused talent). In dental settings, lean can streamline clinical workflows, lab processes, patient scheduling, and ordering systems to reduce surplus consumables and idle time.

3.3 Hybrid Framework[7,9]

The MDPI study analysed the integration of lean and CE in dentistry, showing reduced consumable use, cost, and improved recycling outcomes. This hybrid model encourages clinics to:

- Audit and map clinical processes
- Identify waste types (physical and procedural)
- Implement interventions
- Monitor performance through lean metrics
- Engage suppliers in circular procurement

4. Practical Strategies & Innovations

4.1 Waste Segregation and Audits[7,4,9]

Conducting routine waste audits dividing waste into categories helps identify target reduction areas. Following an audit, clinics can implement color-coded bins and visual reminders a study reported marked reductions in cross-contamination and disposal costs.

4.2 Material Reuse and Upcycling[1,9,10]

- Recycled gypsum: A dental college demonstrated gypsum could be recycled multiple times with no loss in quality for models.
- GIC repurposing: Fragmented glass ionomer cement can be used for polishing or powder avoiding landfill.
- Dental wax recycling: Up to 80-90% reclaimed via simple filtration in lab settings.
- Autologous bone from wisdom teeth: Processed using a bone crusher for grafting demonstrating regenerative reuse.

4.3 Closed-loop Equipment and Supplier Programs[1,4,9,11,12]

- Amalgam separators remove 90% of mercury before it enters wastewater, coupled with recycling contracts.
- Instrument sharpening/refurbishing: e.g., Hu Friedy's Environ Dent program offers trade-in for refurbished tools.
- Modular equipment: Enables replacing components instead of entire units, saving resources.

4.4 Plastic Reduction and Recycling[2,3,4,13]

- Minamata inspired amalgam segregation has succeeded worldwide.
- Smart scanning and printing workflows reduce 35% of polymer usage via optimized alignments.
- Chemical and mechanical recycling: While mechanical recycling requires separation and yields low-grade plastics, chemical recycling (hydrolysis, hydrocracking) is promising for mixed polymers.

4.5 Digital Dentistry[1,2,4,12]

- Digital radiography eliminates developer/fixer chemicals and lead foils.
- Intraoral scanning removes need for alginate and gypsum impressions.
- 3D printing produces fewer scrap casts and supports just-in-time, custom fabrication.

4.6 Teledentistry[3,14]

Remote consultations reduce travel emissions one UK study linked it to reduced CO_2 as part of NHS Net Zero targets. Beyond ecological gain, it reduces packaging and physical record use.

5. Case Studies and Industry Partnerships

5.1 Lean + CE in Dental Clinics[8,15]

A 2023 MDPI study integrated lean and circular practices in commercial clinics, reporting reduced consumable usage, increased recycling rates (80% plastics), and profit margin increases.

5.2 TerraCycle Oral Care[16,17,18]

TerraCycle's zero-waste collection programs for toothbrushes, tubes, and packaging illustrate industry-community collaboration. Patients and clinics can return used items for recycling into new products.

5.3 Philips-TerraCycle Electric Toothbrush Recycling[18,19]

Philips partnered to reclaim brush heads and handles, regenerating materials into consumer goods an example of closed-loop consumer-care CE in dentistry.

5.4 University Clinic Waste Audit[7]

At a Spanish dental school, audits revealed high volumes of sterile wrapping. Recycling these wrappers via commercial recyclers led to a reduction of ~10kgCO_2e per chair per year, plus cost savings on disposal.

6. Barriers, Risks and Solutions

6.1 Infection Control vs Reuse[9]

Infection control remains the top priority, especially post-COVID. Reusable instruments must be rigorously sterilized, and regulations require strict traceability. Solutions include clear risk frameworks and standards for reuse.

6.2 Regulatory Hurdles

E waste isn't fully covered by dental waste laws. Digital policy lag hinders broader adoption of eco-friendly practices. Advocacy for inclusive, sector-wise regulations is vital.

6.3 Financial and Practical Obstacles

Initial investments (e.g., chemical recyclers, amalgam separators) may deter smaller clinics. Incentives, grants, or sharing programs can ease transition.

6.4 Behavioral and Cultural Change[20]

Clinicians express both environmental concern and frustration at waste vs sterility tensions. Education, peer benchmarking, and emphasizing cost-sustainability synergies can shift culture.

6.5 Plastic and Chemical Recycling Limitations

Some polymers cannot be easily recycled; chemical recycling remains costly. Manufacturers must redesign packaging for recyclability. Clinics can choose suppliers with reusable packaging.

7. Future Directions & Policy Implications

7.1 Technological Innovation[2,14,16,17]

- AI and automated sorting: Computer vision to segregate waste accurately for recycling.
- Smart 3D printing: Biobased or compostable filaments, multi-material printers.
- Reverse logistics: Optimized systems for collection, transport, and recycling of dental waste.

7.2 Supply Chain and Purchasing

Procurement should prioritize CE-compliant suppliers those offering take-back, reusable packaging, modular equipment, and sustainable materials.

7.3 Education and Professional Stewardship

Dental curricula must include eco-dentistry, CE, and lean principles. Continuing education can support practicing clinicians in eco-adaptation.

7.4 Policy and Incentives

Government funding, grants, tax credits, and insurance reimbursement for CE-adherent practices bolster transition. Global frameworks like expanded Minamata and WHO CE recommendations for healthcare should be reinforced.

7.5 Measurement and Certification

Development of standardized eco-dentistry audits, green or CE certification, life-cycle assessment tools, and carbon foot-printing can legitimize and guide progress.

8. Conclusion

Dentistry stands at a pivotal moment. From linear waste-generation to circularity is possible practically, financially, and ethically. By auditing waste, upgrading workflows through lean-thinking, fitting clinics with CE-compatible equipment, and engaging staff, suppliers, and regulators, dental practices can become forefronts of environmental stewardship.

This is not merely about being "green" it's about professional responsibility, resilience, and

long-term sustainability. The journey to circular dentistry aligns patient care excellence with planetary care, emphasizing that oral health professional's care not only for patients but also for the environment and future generations.

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REVIEW ARTICLE

NEEDLELESS ANESTHESIA: CHANGING THE LANDSCAPE OF CONVENTIONAL ANESTHETIC TECHNIQUES

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ABSTRACT

The introduction of needle less anesthesia represents a significant advancement in pain management and patient care, especially for individuals with needle phobia or high anxiety. This article explores the current technologies with needle free delivery of local anesthetic agent such as jet injectors. Emphasis is made on their mechanisms of action, clinical efficacy, safety, and application in dental procedures. Various studies highlights benefits such as reduced patient discomfort, improved compliance, and minimized risk of needle-stick injuries. Challenges, including cost, patient prefernces are also discussed. As technology advances, needleless anesthesia seems to be a promising alternative in clinical practice, offering a more comfortable and accessible approach to local anesthesia.

Keywords: Local anesthetic agent, needle stick injury, pain management.

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INTRODUCTION

The preliminary objective of a dentist is to provide maximum comfort to the patient and to perform procedures with minimal pain. One of the most distressing aspects of a dental visit for many individuals is the fear and anxiety associated with the clinical environment particularly the use of syringes and needles for injections. This fear, commonly known as "needle phobia" or blenophobia can be troubling. The mere sensation of a needle attached to a syringe penetrating the oral mucosa often causes significant psychological discomfort and can leave a lasting negative impression on the patient.[1]

According to a recent study, its shows that a vast majority of children exhibit needle phobia. This fear is also prevalent among adolescents and young adults, affecting approximately 20-50% and 20-30% of these groups, respectively. In the context of dentistry, the reported prevalence of needle fear among patients undergoing dental treatment ranges widely from 11.7% to as high as 91%. This fear has been significantly associated with the cancellation or avoidance of dental appointments.[2,3] Needle stick injuries represent a significant concern in dental practice. These incidents commonly occur during the resheathing or disposal of needles, particularly among less experienced individuals. The risk of transmitting blood-borne viruses such as HIV, hepatitis B, and hepatitis C through needle stick injuries poses a serious threat not only to dental professionals but also to medical waste management personnel.[2] Considering the impact of both needle phobia and needle stick injuries, the need for an alternative method that eliminates the use of needles has become increasingly evident. In response to this need, Hingson and Hughes developed a novel injection technique based on a different principle one that does not involve needles.[2]

This innovation, known as pressure injection or jet injection, offers a promising needle-free approach to delivering local anesthesia.[2] John F. Roberts introduced the jet injection syringe in 1933, marking a significant step toward needle-free drug delivery. Neverthless, it was not until 1947 that needleless injection was introduced into clinical practice representing the first major advancement in injection technique since Alexander Wood's introduction of the hypodermic needle in 1853.[1] Jet injection which is designed with the principle of pressure dynamics, where the anesthetic solution is distributed through a small aperture under high pressure, allowing it to penetrate to the gingival tissue and reach the subcutaneous tissue without the help of a needle. Since its development, several jet injection devices have been introduced and studied. Notable examples include Hypospray, Syrijet Mark II, Panjet, Madajet XL, Injex and Comfort-In[2].The current consensus is that jet injection techniques are primarily effective for surface anesthesia and, therefore, are considered supplementary rather than a replacement for conventional infiltration techniques.[4]

Clinical applications in dentistry

Most dental procedures, including extractions and endodontic treatments, tend to cause pain in patients. One of the major challenge that dentists face in clinical practice is pain & anxiety management.[1] So, most of the procedures in dentistry needs local anaesthesia conventional method of delivering local anaesthesia was injection techniques. The fear of dental injection is the most anxious aspect for an average dental patient.[1]

Even though the traditional injection techniques produce necessary sensory and motor blockade, needle phobia exhibited by patients are left unresolved.[5] The recent use of pressure syringes or jet injections is used as a treatment approach in medicine and dentistry.[1]

The jet injection systems such as Madajet (Mada Medical Products, USA), Injex (INJEX Pharma AG, Germany), and Comfort-in (Mika Medical Co, South Korea) have been used in dentistry for local anesthesia procedures. Needle-free jet injection delivers local anesthetic as a heavy-speed stream about the diameter of human hair, and it is considered a promising way to possibly get over fear and anxiety. This high speed stream of local anesthetic is brought about by applying high amount of pressure to the fluid which is usually achieved by releasing a compressed spring. Jet injectors have been using for dental treatment since the '70s, with systems such as Syrijet (Keystone Industries, USA) and Panjet (Wright Health Group Ltd, UK) promoting effective anaesthesia of the target tissue and enhanced patient compliance.[6]

Recently, alternatives to spring-driven jet injection systems have been investigated for dental anesthesia, including jet injectors powered by compressed air and controllable electric motors.[6] Madajet XL is an autoclavable jet injection device which delivers the anesthetic solution with the help of a mechanical pressure system. The high pressure exerted by the it causes the anesthetic solution to infiltrate the tissue in small droplet form, which is instantly taken up by the myelin sheath of the nerve.[1] In children, NumBee was used for needleless anesthetic delivering device in order to reduce the pain caused by conventional injection as it eliminates the potential damage that could be caused by a needle which in turn would enhance the children's attitude towards the dental treatment.[7]

For periodontal procedures such as scaling, root planing, and flap surgeries, needle-free jet injectors have been utilized successfully. Patients reported reduced pain level and anxiety during anesthesia administration with jet injectors compared to traditional syringe method.[8]

In restorative procedures, needle-free anesthesia has been used in providing anaesthesia for treatments such as Class I and II fillings.[9] It is a promising alternative in endodontic treatments, particularly for patients with symptomatic irreversible pulpitis undergoing root canal therapy.[10]

The needle free injection techniques such as Comfort-In, can be used by dental students which could help them gain their confidence before utilizing needle injections. This helps to reduce the needle stick injuries in dental schools.[2]

Advantages of needleless anesthesia[11]

a) Avoids the hazards of puncturing skin, do not cause bleeding.

b) Greater shelf-life is achieved by formulating the drug as a dry powder, which is ideal for water sensitive medications.

c) Overcoming needle phobia

d) Self-administration is feasible

e) Ensures fast drug delivery and more reproducible

f) Vaccines for influenza, tetanus, typhoid, diphtheria, hepatitis A can be administrated.

g) Improved therapeutic effect was noted as the drug dosage was raised.

h) Minimizes the risk of reconstitution mistakes and shear induced damage.

i) Convenient functionality

Disadvantages of needless anaesthesia[11]

a) The approach is intricate and costly.

b) The technique is complex and expensive.

c) The method is technically demanding.

d) Customization is required.

e) It cannot be used in intravenous route.

f) Pressure feeling during anaesthesia delivery and the chance of hematoma.

Challenges associated with needleless anaesthesia

1. **Interface pressure:** A consistent and secure force between the injector tip and the skin must be applied by the dentist, as inadequate contact may result in improper delivery depth of the medication.[12,13]

2. **Cost:** The high-cost relative to traditional syringes.[12]

3. **Contamination:** As the device is devoid of needle, it doesn't have a needle protector. The jet stream is exposed to the external environment at the point of injection, introducing a slight but possible contamination risk during use.

4. **Splashing:** The threshold velocity required for effective penetration is influenced by the rigidity, thickness and anatomical location of the injection site. Once the skin is breached, continous jet pressure can allow the substance to penetrate deeper into the tissues. If the volume administered surpasses the puncture's capacity, a portion of the medication may be expelled outward, leading to partial or unsuccessful delivery. The backflow or splashing presents a significant concern, as traces of blood on the tips of multi-use jet injector nozzles

have been linked to the spread of hepatitis B.[10]

5. Sudden noise during application[12]
6. **Driving pressure:** Diving pressure more than 435 psi leads to potential skin injury and also underlying soft tissue injury.[12]
7. The technique is uncommon among healthcare professionals.
8. Momentory action and low depth
9. Patient preference :Certain individuals might favour the conventional needle technique because of its kno wn routine and assumed reliability.
10. Unstable efficacy

Needle-free liquid jet injection systems are infrequently implemented in dental settings, primarily due to their variable effectiveness and unpredictable side effects, such as discomfort, unpleasant taste, and pain. In the case of local infiltration anaesthesia, the aesthetic agent must be administered precisely to block the minor nerve endings at the roots of the teeth. The dentoalveolar area presents a distinct set of challenges for NFLJI, owing to the presence of dense bone structures beneath a thin soft tissue layer. Within this framework, we proposed that the presence of hard tissue in the dentoalveolar zone may influence the fluid behaviour of needle free liquid jet injection system suggesting that the angle of administration could impact its effectiveness.[14]

The evolution of pain management in dentistry has improved not only clinical efficacy but also patient comfort. The traditional use of hypodermic needles, while clinically effective, is frequently associated with heightened anxiety, avoidance behavior, and compromised patient comfort. Jet injection technology, based on the principles of high-pressure delivery systems, has emerged as a alternative to conventional syringe-based anesthetic technique.[2] Devices such as Madajet XL, Comfort-In, and Injex have shown efficiency in dental procedures involving local anaesthesia.[6]

In spite of the advantages exhibited by jet injectors, the widespread acceptance of it remains limited. One of the primary concerns is that it is comparatively expensive than traditional anaesthetic technique.

Risk of hematoma, and operator training complexity further reduce their practicality in routine dental practice.[11]

With further technological advancements and clinical training, the limitations of current systems may overcome, making needle-free anesthesia a more accessible and reliable option in everyday dental practice.

CONCLUSION

Needle-free jet injection systems represent a significant advancement in the field of pain management in dentistry, offering a promising alternative to conventional needles by reducing needle phobia and minimizing the risk of needle stick injuries. These systems enhance patient comfort, particularly among children and individuals with high dental anxiety, and align with the principles of a traumatic dentistry.

However, their current limitations including high cost, mechanical complexity, and limited efficacy in dense oral tissues makes it to be used with caution. While it is not a complete alternative for traditional techniques, jet injectors can play a pivotal role as an adjunct in dental anesthesia, especially for procedures requiring surface level numbing.

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CASE REPORT

ODONTOGENIC KERATOCYST: A CASE REPORT AND CLINICAL INSIGHTS

ABSTRACT

Odontogenic Keratocyst (OKC) is a rare, benign but locally aggressive cyst arising from the dental lamina. It often presents asymptomatically and is discovered incidentally on radiographs. However, in some cases, it can present with pain, swelling, or other symptoms. This case report discusses a 16-year-old male patient presenting with pain in the lower right posterior tooth region, where radiographic examination revealed a large cystic lesion associated with the impacted mandibular third molar.

Key words: Odontogenic keratocyst, impacted tooth, enucleation, parakeratinized epithelium, CBCT, recurrence.

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INTRODUCTION

Odontogenic keratocyst (OKC), first described by Philipsen in 1956, is a unique jaw cyst arising from remnants of the dental lamina. Representing approximately 10-12% of all odontogenic cysts, OKCs predominantly affect individuals in their second and third decades of life, with a slight male predominance[1,2]. The posterior mandible, particularly the ramus and angle region, is the most commonly affected site.

Histologically, OKCs are lined by parakeratinized stratified squamous epithelium exhibiting a corrugated surface and palisaded basal cells. These features, along with the presence of daughter cysts or satellite cysts within the fibrous capsule, account for their aggressive and recurrent nature[3,4].

Clinically, OKCs may be asymptomatic or manifest as swelling, pain, discharge, or facial asymmetry depending on the lesion's size and location. Radiographically, they present as unilocular or multilocular radiolucencies with well-defined, corticated margins, often associated with impacted teeth. Advanced imaging such as CBCT assists in assessing the extent and cortical involvement[5].

Recent molecular studies have linked OKCs to mutations in the PTCH1 gene and hedgehog signaling pathways, especially in syndromic cases such as nevoid basal cell carcinoma syndrome (Gorlin-Goltz syndrome)[6]. These genetic insights have prompted debates regarding the cyst's neoplastic potential, leading to a temporary reclassification by the WHO in 2005 as "keratocystic odontogenic tumor", although it reverted back to cyst status in 2017 due to insufficient neoplastic evidence[7].

This case report presents the diagnosis and successful management of OKC in a teenage patient and emphasizes the need for a multidisciplinary approach to reduce recurrence risk.

CASE PRESENTATION

Patient Information:

A 16-year-old male patient presented to the outpatient dental department with a chief complaint of pain in the lower right back tooth region for the past 10 days. The pain was dull and intermittent. Patient gives history of mild swelling and discharge past 2 weeks. The patient's medical and dental histories were unremarkable.

Clinical Examination:

Fig.1 Extraoral photo of the patient

Fig.2 Intraoral photo of the patient

Extraoral examination (FIG-1) revealed mild facial asymmetry.

Intraoral examination (FIG-2) showed a partially erupted tooth #48 (lower right third molar) with mild tenderness on percussion.

The surrounding gingiva appeared normal, and there was slight sign of discharge.

Radiographic Features:

An orthopantomogram (OPG) (FIG-3) revealed a well-defined, unilocular radiolucent lesion associated with the impacted tooth #48. The lesion extended from the distal root of tooth #47 to the mandibular angle. The margins of the cystic lesion were corticated, indicating a slow-growing process. The mandibular canal appeared displaced inferiorly.

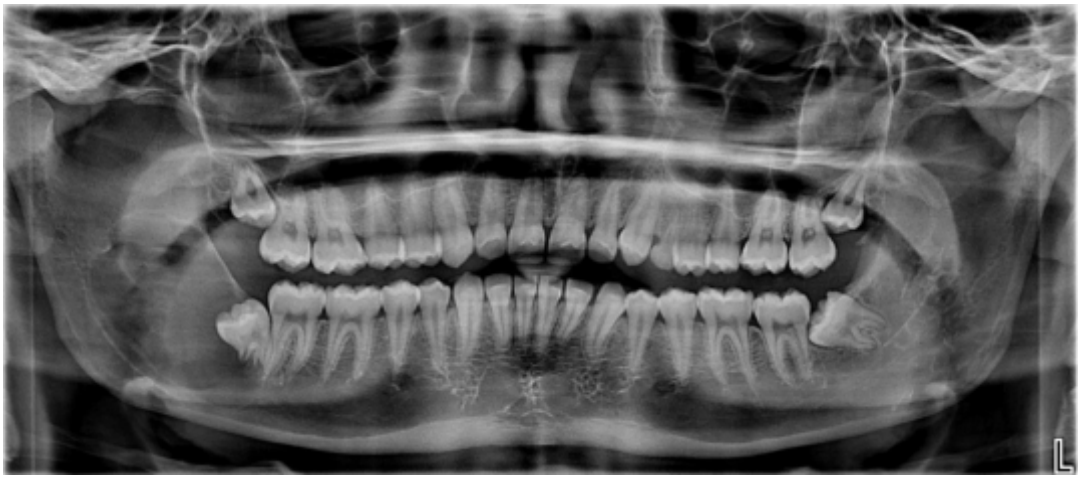

Fig.3 Pre-operative Radiograph

CBCT Findings:

A well-defined corticated unilocular radiolucent lesion is noted around the disto-angulary impacted 3rd molar & ramus region. It measures about 37mm (superior-inferiorly) x 44mm (antero-posteriorly) x 11 mm (Bucco-lingually). The lesion extends superior-inferiorly from the right ramus up to the inferior border of the mandible & mesio-distally it extends from the mesial root of 48 up to the lingula. Thinning of the buccal & palatal cortical plate noted with intermittent disruption of the lingual cortical lining. External root resorption is noted in relation to 48. The cusp tip of 48 is almost at the level of the alveolar crest. Inferior displacement of the mandibular canal noted along with intermittent disruption of the cortical lining.

Differential Diagnosis:

Based on the clinical and radiographic findings, the following differential diagnoses were considered:

1. Odontogenic keratocyst (OKC)
2. Dentigerous cyst
3. Ameloblastoma (unicystic variant)
4. Radicular cyst (less likely due to the vitality of adjacent teeth)

Management:

Under local anesthesia, an incisional biopsy of the lesion was performed, and the cystic lining was sent for Histopathological analysis. Enucleation of the cyst along with the extraction of tooth #48 was planned and performed under general anesthesia. Careful curettage of the cavity walls was carried out to minimize the risk of recurrence. (FIG-4,5,6)

The histopathological report confirmed the diagnosis of an odontogenic Keratocyst, showing a Parakeratinized stratified squamous epithelium lining with a corrugated surface and a thin, fibrous connective tissue wall.

Fig.4 Incisions placed

Fig.5 Lesion excised

Fig.6 Extracted tooth

Histopathological Report:

Section showed cystic line by stratified squamous epithelium with hyper chromatic pallisading basal layer and wavy corrugated parakeratotic epithelial cells. Partial lining of granulation tissue infiltrated by lymphocytes, plasma cells and neutrophils seen. Clefting between epithelium and fibro-collagenous wall was seen.

Postoperative Follow-Up:

The patient was followed up at regular intervals. Postoperative healing was uneventful, with no signs of infection or recurrence during the 6-month follow-up period and then after a year. Radiographs showed satisfactory bone regeneration in the affected area. (FIG-7,8)

DISCUSSION

Odontogenic keratocyst is a developmental cyst originating from the dental lamina and is frequently associated with impacted teeth. It has a high recurrence rate due to its aggressive nature and the potential presence of daughter cysts.[6,7]

In the present case, the cyst was discovered due to the patient's complaint of pain, though many OKCs remain asymptomatic and are identified incidentally. Radiographic features, including a well-defined radiolucent lesion

6 Months follow-upOPG

FIG-7- POST-OPERATIVE RADIOGRAPH

1 year follow-up

FIG-8- POST-OPERATIVE RADIOGRAPH

with corticated margins, were consistent with OKC. Histopathology remains the gold standard for diagnosis, with characteristic parakeratinized epithelium.

The management of OKC involves surgical enucleation, curettage, and sometimes adjunctive therapies like chemical cauterization or marsupialization, especially for large lesions. Several authors suggest using a "site- and size-based" approach for treating KOT. According to Dammer et al[4] a conservative approach is recommended for small OKCs (up to 1 cm in diameter) located near the alveolar process, while larger lesions that have invaded soft tissue require radical excision. In contrast, Forsell and colleagues[5] argue that the size of the lesion does not influence the recurrence rate.

A recent systematic review by Al-Moraissi et al. (2021) found that adjunctive therapy combined with enucleation significantly lowers recurrence rates compared to enucleation alone[8]. Moreover, cryotherapy has been shown to be effective in reducing recurrence in large lesions but carries a risk of damaging adjacent neurovascular bundles[9].

Emerging evidence also emphasizes the role of molecular biology in the pathogenesis of OKCs. Mutations in the PTCH1, SUFU, and SMO genes components of the Sonic Hedgehog signaling pathway have been implicated in both sporadic and syndromic OKCs. A 2022 study by Cai et al. demonstrated that PTCH[1] mutations were present in over 85% of sporadic OKC samples, reinforcing its central role in cyst development and progression[10].These findings open avenues for molecular-targeted therapies, such as the use of vismodegib, a hedgehog pathway inhibitor, although its clinical use remains limited to syndromic and neoplastic variants [11].

Long-term follow-up is essential. Multiple studies have reported recurrence as late as 10-15 years post-surgery, supporting the need for at least a 5-10year radiological follow-up protocol[12,13]. Advanced imaging techniques such as CBCT offer superior detection of residual or recurrent lesions compared to conventional radiographs.

Ultimately, treatment decisions must be tailored based on patient age, lesion size and location, proximity to vital structures, and recurrence history. In younger patients, conservative approaches that balance efficacy and preservation of tissue are often preferred, though they must be closely monitored for recurrence.

CONCLUSION

This case highlights the importance of early diagnosis and appropriate management of odontogenic keratocysts. Although benign, their aggressive nature necessitates careful surgical treatment and long-term follow-up to prevent recurrence. A multidisciplinary approach involving radiographic, Histopathological, and surgical expertise is key in managing such lesions.

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REVIEW ARTICLE

TELEDENTISTRY: REVOLUTIONIZING DENTAL CARE THROUGH TECHNOLOGY

ABSTRACT

Teledentistry, a subset of telehealth, leverages telecommunications and information technology to deliver remote dental care, education, and consultation. This rapidly evolving field addresses barriers to oral healthcare access, particularly in underserved and rural areas. Teledentistry encompasses two primary forms: store-and-forward (asynchronous) and real-time (synchronous) consultations, as well as remote patient management. Teledentistry offers numerous benefits for patients and dentists, including reduced costs, increased accessibility, and improved continuity of care. Its applications span various dental specialties, such as oral medicine, orthodontics, pedodontics, prosthodontics, and periodontics. Teledentistry facilitates specialist consultations, emergency care, and patient education, ultimately enhancing patient outcomes. Despite its advantages, teledentistry faces challenges related to image quality, internet accessibility, licensure, and liability. Technical issues, data security concerns, and the need for standardized protocols also hinder its widespread adoption. Teledentistry has the potential to transform dental care delivery, particularly in resource-constrained settings. As technology advances and regulatory frameworks evolve, teledentistry is poised to play an increasingly important role in shaping the future of oral healthcare. Further research and investment are necessary to overcome existing challenges and fully realize the benefits of teledentistry.

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INTRODUCTION

As technology and telecommunications advance, the healthcare landscape is undergoing significant transformation. Hospitals have adopted various telecommunications systems, leading to the coining of the term "telemedicine." This concept utilizes communication networks to provide healthcare services and medical education across different regions, addressing challenges like unequal access, insufficient infrastructure, and limited human resources. In a similar vein, teledentistry leverages information technology to offer dental care remotely, eliminating the need for in-person patient interactions.[1] The origins of teledentistry can be traced back to telemedicine. According to the Association of American Medical Colleges (AAMC), telemedicine involves using telecommunications technology to transmit data, graphics, audio, and video between participants who are not in the same location, all for the purpose of clinical care.[2] The World Health Organization (WHO) defines telemedicine as the provision of healthcare services where distance is a crucial factor, utilizing information and communication technologies to exchange valid information for treating and preventing diseases and injuries, conducting research and evaluation, and providing ongoing education for healthcare workers, all aimed at improving the health of individuals and communities.[3] The foundational idea of teledentistry was part of a dental informatics blueprint created during a 1989 conference funded by the Westinghouse Electronics Systems Group in Baltimore. Subsequently, in 1994, the US military launched a teledentistry project to support US troops globally.[4]

Need for Teledentistry

Teledentistry has become important as a solution to overcoming barriers to oral healthcare. It provides an effective and efficient mechanism to render dental services in underserved and rural areas, where access to professional dental care is limited. Given the global shortage of dentists, which is projected to worsen in the coming decade, teledentistry has become a more dependable solution. Moreover, it enables professional connection and cooperation between general dentists and specialists for better patient service. It also offers unique opportunities for amalgamating oral health into the larger healthcare system to improve the quality of care.[5]

Types of Teledentistry

Information and communication technology (ICT) is advancing rapidly. Teledentistry facilitates oral healthcare access globally, linking patients, dentists, and specialists for diagnosis and treatment through established communication channels.[1] Teledentistry primarily consists of two types:

a) Store and forward method/ pre-recorded/ asynchronous systems:

In the store and forward approach, dental professionals collect and store necessary clinical data, including digital intraoral and extraoral images and radiographs, which are then shared for consultation through established networks[2]. This information can be securely archived for future reference, ensuring a comprehensive record of the patient's dental history[6]. Dentists and specialists can easily exchange this information and consult with other experts for opinions and advice.[1]

b)Real-time method/ synchronous systems:

Real-time consultations involve video conferencing between a dentist and a patient, allowing for simultaneous sharing of data, reports, and medical history. This method facilitates quicker communication with dentists or other specialists and enables information sharing.[6] International health organizations like the WHO, national disease control centers, and various health departments utilize this type[4].

c) Remote patient management:

This recent innovation allows dentists or clinical experts to receive detailed health information directly from patients' homes and easily transmit it to clinical centers.[1] Patients are consistently monitored either from a hospital or at home.[6]

Dentist-Patient Relationships:

In the dentist-patient relationship, mutual trust is essential when the dentist requests necessary details and the patient consents to the dentist's treatment plan. Therefore, this process should be based on mutual agreement. Dentists must thoroughly inform patients about the benefits and potential drawbacks of online consultations. Consequently, obtaining the patient's consent is crucial before the dentist makes relevant decisions, including the suitability of online dental care. For this reason, online dental care is employed only when there is an existing direct connection between the dentist and the patient. The same dentist should conduct face-to-face online dental care.[1]

Applications of Teledentistry in various Dental Fields:

A) ORAL MEDICINE AND RADIOLOGY:

- Patients often present with primary complaints of oral ulcers, lesions resembling oral cancer, temporomandibular joint disorders, and infectious orofacial lesions.
- These conditions require prompt attention, as delays can be life-threatening. In such cases, teleconsultation and immediate treatment offer hope to these patients.
- Images can be captured using smartphones, and digital images can be sent as digital radiography, minimizing radiation exposure and protecting patients from unnecessary harmful radiation.[4]

B) ORAL AND MAXILLOFACIAL SURGERY:

- Patients suffering from conditions like temporomandibular disorder, salivary gland issues, head and neck cancer, and those needing orthognathic surgery often require additional assessment due to the challenges of conducting a typical "face-to-face" consultation[1].
- With advancements in technology and computer-assisted dental implant placement, it is feasible to assess a patient in one location and create a digital plan for complete implant and prosthetic fabrication in another, subsequently guiding the dental implantation process[2].
- This facilitates preoperative planning and ensures timely and precise interventions through remote consultations[5].

C) CONSERVATIVE & ENDODONTICS:

- Expert endodontists can assist general dentists in locating root canal orifices by offering advice and guidance over the phone on identifying root canals.
- It has also proven effective in diagnosing periapical lesions in the anterior teeth[1].
- Research indicates no significant difference in the accuracy of detecting periapical lesions when using traditional radiographs compared to those sent via telecommunication systems[5].

D) ORTHODONTICS:

- Virtual consultations and AI-based treatment monitoring using photos or videos are now the primary online communication technologies in orthodontics.
- Teledentistry is beneficial for evaluating treatment options and diagnosis plans, measuring calibration and orientation, and assessing functional and removable appliances.
- Minor orthodontic issues such as rubber ligature displacement, pain, and cheek irritation can be managed at home through teledentistry, reducing the need for in-person dental visits[1].
- With teleassistance in orthodontics, practitioners can maintain consistent monitoring, handle some emergencies, or even remove dentofacial orthopedic appliances[3].
- Interceptive orthodontic treatments provided by trained dentists and supervised remotely by orthodontic specialists can lessen the severity of malocclusions in children[5].
- A positive attitude was observed among young practitioners and those working in teaching institutions towards teleorthodontics, likely due to the

increased use of electronic devices by younger practitioners[7].

E) PEDODONTICS

- For pediatric patients, preventive counseling, dietary charts, and high-strength sodium fluoride toothpaste can be provided over the phone to initiate treatment.
- Some pediatric patients may be referred to a pediatric dentist for issues like delayed tooth eruption, tooth exfoliation, or developmental problems such as neonatal teeth.
- One of the primary advantages of teledentistry is that it removes the need for patients and parents to travel and leave work or school to visit a dentist[1].
- Mobile gaming apps offer children an interactive way to manage their behavior and help facilitate face-to-face interaction by reducing the frequency of dentist visits. These apps may use behavior coaching techniques like "tell-show-do," "positive pre-visit counseling," "distraction," and "modeling"[6].
- The use of CAMBRA (Caries Management by Risk Assessment) for remotely screening children and providing guidance on preventive practices like toothbrushing, interdental cleaning, and fluoride use saves time and resources, particularly in underserved areas[5].

F) PROSTHODONTICS

- Teledentistry has been employed to broaden treatment plans for patients needing oral rehabilitation, especially in less populated regions[5].
- The primary issue in this field of dentistry is often broken or dislodged prostheses, which prosthodontists can address by guiding patients on how to manage these issues.
- Dental technicians can also create dental prostheses through teledentistry. In this process, the prosthodontist sends a digital impression of the oral cavity to the technician, who then fabricates the prosthesis and delivers it to the patient's home[4].
- Research has also indicated that during the pandemic, teledentistry could be utilized for all prosthodontic cases, whether emergencies or non-emergencies, followed by portable/mobile dentistry[3].

G) PERIODONTICS

- Through teledentistry, clinical photographs of patients, both intraoral and extraoral, along with necessary radiographs, are sent to the periodontist for consultation. The periodontist reviews these and formulates a treatment plan. A study conducted by the US Department of Defense dental clinics demonstrated significant improvements in patients' periodontal health[4].

H) PUBLIC HEALTH DENTISTRY

- Teledentistry offers a unique method for delivering long-distance clinical training, continuing education, and hands-on training to dentists and dental hygienists in remote clinics.
- It aids in patient motivation and education about self-care, saving time and money on additional appointments.
- It requires minimal technical equipment, allowing users at both ends to communicate face-to-face. In India, primary health centers and community health centers can be equipped with teledentistry to enhance education and services in society.
- General dental surgeons and dental hygienists can be stationed at sub-centers to provide affordable dental care[2].

I) OTHER APPLICATIONS

a) Teleconsultation:

The most common form of teledentistry is teleconsultation, where patients or local healthcare providers seek advice from dental specialists via telecommunication. It has been primarily used for consulting patients who are physically and intellectually challenged, as well as those in old age homes and prisons. Teleconsultation has been shown to reduce referrals from primary health centers to higher centers by over 45%. During the COVID-19 pandemic, it may help patients continue their therapy during quarantine and lockdown[8].

b) Telediagnosis:

With the introduction of teledentistry into oral health services, patients can easily access diagnosis and management of their oral health issues. Teledentistry aids in the early detection of malignant lesions, enabling quicker treatment for oral cancer and improving the effectiveness and safety of therapy by facilitating communication between dentists and clinical specialists[1]. An addition to telediagnosis is telecytology, a system for early detection of potentially malignant or malignant oral lesions, and Mobile Mouth Screening Anywhere (MeMoSA) to facilitate early detection of oral cancer, proving beneficial for patients with limited access to specialists. A tablet-based mobile microscope (CellScope device) is used as an adjunct for oral cancer screening[8].

c) Teletriage:

Teletriage is the process of safely, appropriately, and promptly managing patient symptoms through smartphones by specialists. It has been utilized for remotely assessing school children and prioritizing those in need of dental care, thereby eliminating unnecessary travel[8].

d) Telemonitoring:

Telemonitoring can substitute frequent in-person visits with virtual ones for regular monitoring of treatment outcomes and disease progression. During the pandemic, telemonitoring emerged as a promising tool for remotely overseeing both surgical and non-surgical dental patients, notably reducing costs and wait times[8].

e) Dental education:

Online education in dentistry can be categorized into two main types: web-based self-instruction and interactive video-conferencing. The web-based self-instruction system provides pre-stored information that users can access at their own pace, allowing them to control their learning speed and review materials. However, it has drawbacks in terms of satisfaction and accuracy. Interactive video-conferencing, conducted via POTS, satellite, ISDN, Internet, or Intranet, includes live interactive sessions and supportive information (such as a patient's medical history and radiographs) that can be sent before or during the video conference (with or without the patient present). This educational method's advantage is the immediate feedback users can receive[2].

f) For special people:

Patients with disabilities:

- The statement, "Any disabled person has the right to benefit from the full solidarity of the national community, which, as part of this national duty, guarantees access to essential care recognized for all citizens and ensures the full exercise of citizenship," originates from the law on the rights, opportunities, participation, and citizenship of disabled individuals, enacted on February 11th, 2005. However, in practice, this promise remains unfulfilled.
- Recent international studies highlight the inadequate state of dental care for this group, showing higher rates of untreated dental issues and poor oral hygiene practices. This population is recognized as being at high risk for dental diseases.
- In addition to traditional risk factors, contributing elements include medication use, neuro-motor and sensory impairments, comorbidities, and behavioral changes. Non-cooperative behavior in some individuals with disabilities further necessitates a preventive approach to avoid worsening oral health[5].

Medically compromised:

- Telehealth provides the ability to reach a broad range of individuals, particularly those with weakened immune systems, pre-existing medical conditions, or family responsibilities like child care, by minimizing unnecessary contact and supporting physical distancing. This is especially advantageous for older adults and individuals who are home-bound or living in long-term care facilities populations highly vulnerable to severe complications from COVID-19[5].

Underserved communities:

- In rural areas, several barriers prevent people (racial and ethnic minorities,

individuals with mental or physical challenges, and those from low-income families, especially children) from receiving dental care, including geographic isolation, poor infrastructure, adverse weather conditions, lack of public transportation, poverty, absence of health insurance, and a shortage of dentists relative to the population.

- By facilitating teleconsultations with specialists from larger communities, teledentistry extends affordable care to underserved populations, particularly those in rural areas, at a reasonable cost.
- It also reduce the oral health disparities between rural and urban populations[5].

TELEDENTISTRY AND COVID-19:

With the resurgence of interest in aerosol-generating procedures (AGPs) due to the COVID-19 pandemic, numerous publications have focussed on essential response strategies, offering management protocols for dental professionals. In dental settings, various activities involve close patient interaction, exposure to bodily fluids, use of aerosol-producing tools, and the airborne transmission of saliva and other biological fluids. Telemedicine and teledentistry have facilitated remote consultations and follow-ups, eliminating the need for physical presence in medical or dental offices.[3] The swift adoption of teledentistry by dental professionals during the COVID-19 pandemic presents a valuable opportunity to examine its application in both short-term and long-term dental care, while also ensuring a safe environment that minimizes infection risk. Dentists can utilize online teledentistry consultations to offer necessary guidance, monitor a patient's condition repeatedly, and address emergency dental issues during and after the pandemic. Currently, it is crucial for dental services to have access to video consultation solutions to enhance triage services for those in need. Implementing video consultations will help reduce patient contact during the recovery and restoration phase of the COVID-19 outbreak and in the future. This approach will enable practices to manage the backlog of patients who currently lack access to dental care and prioritize those with urgent treatment needs, facilitating the gradual return to routine dental care.[1]

ADVANTAGES OF TELEDENTISTRY:

Benefits for patients:

- More affordable than in-person dental care.
- Patients and their families can choose a dentist based on their preferences.
- In emergencies, patients can directly contact a dentist from a remote location, saving time, money, and unnecessary hospital or clinic visits.
- Enables obtaining a second opinion from a dental specialist.[1]
- Reduced patient exposure due to digitalization of techniques and equipment.[4]
- Educational opportunities for both patients and dental professionals.[5]

Benefits for dentists:

- With fewer clinic visits required, chair times decrease, allowing dentists to see more patients daily.
- Dentists can quickly consult with specialists for second opinions.
- Facilitates communication with patients in remote areas.[1]
- Lower service costs and enhanced quality of care.
- Improved diagnostic services.
- Better integration of dentistry into the broader healthcare delivery system.
- Enhanced communication with insurance companies and dental laboratories.[2]
- Reduces the time and effort needed for data storage.[4]
- Follow-up appointments may not always be necessary, as dentists can maintain virtual contact with patients to monitor progress and provide advice as needed.[6]

CHALLENGES IN TELEDENTISTRY

A) ETHICAL & CLINICAL CHALLENGES:

Delivering high-quality healthcare is an ethical duty, guided by the principles of beneficence (promoting good) and nonmaleficence (preventing harm). Teledentistry encounters significant ethical challenges, such as the need to safeguard patient confidentiality, secure informed consent, and navigate intricate licensing requirements. To ensure quality care in teledentistry, it is essential to address access disparities, adhere to ethical standards, and overcome obstacles to patient involvement[5].

B) LEGAL & REGULATORY CHALLENGES

Teledentistry often involves crossing jurisdictional lines, which can lead to licensure-related issues. Besides obtaining informed consent, consultations should clearly communicate the healthcare professional's qualifications, helping patients verify these credentials. Healthcare providers face difficulties in securing reimbursement for teledentistry services. The Centers for Medicare & Medicaid Services (CMS) have set specific guidelines, and many private insurers have yet to implement comprehensive telemedicine coverage, complicating matters for providers.[5] Additionally, dentists must obtain a digitally written and signed informed consent from patients to protect themselves from liability in case of malpractice.[4] The use of electronic health records (EHRs) and other protected health information (PHI) in telemedicine heightens the risk of data-related issues.[5]

C) TECHNOLOGICAL CHALLENGES

Telemedicine faces hurdles due to insufficient technological access, particularly in rural or economically disadvantaged regions. People without access to computers, smartphones, or reliable internet may struggle to participate in teledentistry appointments, limiting their healthcare access. Moreover, elderly patients, who may be less tech-savvy, might find it challenging to navigate telemedicine services. Technical disruptions during a telemedicine session can impede healthcare providers' ability to accurately assess patients, potentially leading to misdiagnosis. Diagnostic errors can be detrimental to both patients and healthcare providers, resulting in inappropriate treatments and increased costs. Furthermore, these disruptions can interrupt telemedicine sessions, preventing patients from receiving necessary care. Some patients may have trouble with digital tools or feel uneasy using telecommunication resources, leading to reduced engagement and diminished trust in teledentistry services.[5]

D) FINANCIAL CONSTRAINTS

Financial challenges include not only reimbursement for healthcare services but also the costs associated with adopting telehealth technologies. Establishing and maintaining telehealth requires investments in technological infrastructure and training on how to use these technologies. Healthcare providers lacking the financial resources or capabilities to implement telehealth may face significant obstacles, creating further barriers to patient access.[5]

E) PRACTICAL CHALLENGES

Numerous dental problems, including inflammation, significant decay, soft tissue abnormalities, loose teeth, and damaged prosthetics, often necessitate face-to-face assessments for accurate diagnosis and treatment planning. These issues highlight the necessity for proper training of dental professionals in the effective use of teledentistry tools. Moreover, a significant barrier to the successful adoption of teledentistry is the lack of technical expertise among dental staff. If practitioners do not possess the necessary skills and confidence to use these digital tools, they may be reluctant to adopt a digital-first approach. Additionally, the conventional healthcare model, which emphasizes interpersonal relationships, builds trust, respect, and mutual understanding. The shift to telehealth changes this dynamic, raising concerns about whether electronic communications can maintain the same level of confidentiality and trust as in-person interactions.[5]

RECOMMENDATIONS FOR EFFECTIVE TELEDENTISTRY PROGRAM

An online consultation involves a dentist examining a patient through an information

and communication device and recommending a dental clinic/hospital for real-time consultation in teledentistry. Promoting and supporting teleconsultation with the minimum necessary diagnosis based on the individual patient's condition, such as selecting the appropriate dental specialty, is crucial. Diagnosing specific conditions (if the diagnosis is accurately made), informing patients of the diagnosis, guiding them on the use of over-the-counter medications, prescribing, etc., are all examples of online medical treatment that can also be conducted via teleconsultation. Additionally, there are instances where follow-up or non-examination instructions are provided to patients with symptoms that clearly do not require a dentist visit or dental treatment based on the patient's individual condition. General consultation advice that does not involve any judgment can be offered as remote health and consultations.[1]

FUTURE & SCOPE OF TELEDENTISTRY

A study published in 2020 involved a robot connected to a 5G network performing a transoral laser microsurgery procedure on a cadaver. The body was located 15 km away from the anatomy lab, where the surgeon removed a polyp artificially attached to the vocal cords.[9] Although teledentistry has existed since the 1990s, its significance was only recently acknowledged during the global pandemic. As the pandemic continues, teledentistry is likely to remain relevant for a long time. Additionally, elderly patients, those with physical disabilities, or those incarcerated for various reasons can benefit greatly from teledentistry, which enables remote dental care. Similarly, for patients residing in rural and hard-to-reach areas, where travel to and from the dental clinic is a major obstacle, teledentistry offers a promising solution.[1] Mobile-health (m-health) is defined by the World Health Organization as medicine supported by mobile devices (mobile phones, patient monitoring devices, wireless devices, etc.), and over the past decade, it has been applied in various medical fields[3].

The primary advancement in this area is the emergence of high-quality software programs that are both affordable and user-friendly for patients and healthcare professionals alike.[1] India has embraced telemedicine to tackle various challenges faced by the healthcare delivery system, such as insufficient and substandard health infrastructure and clinical services, a shortage of qualified doctors, and delays in treatment due to the extended time needed to transport patients to urban healthcare facilities. Three leading hospitals in northern India, namely, the All India Institute of Medical Sciences (AIIMS) in New Delhi, the Post Graduate Institute of Medical Education and Research (PGIMER) in Chandigarh, and the Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) in Lucknow (Uttar Pradesh), are pioneering the implementation of teledentistry.[2]

CONCLUSION

Currently, modern and advanced medical equipment and instruments have made teledentistry a more convenient method for reaching a large number of patients by offering teleconsultation support anytime and anywhere through internet-based media platforms. Raising public awareness about various health issues and disseminating valuable information can be effectively achieved with a large group of targeted patients using this media platform, especially in emergencies. Teledentistry has emerged as an alternative to provide safer patient consultations by reducing the burden on clinics during crises.[1] Teledentistry offers new opportunities for dental education by granting primary care professionals easy access to efficient consultations and facilitating postgraduate education and continuing dental education programs.[2] Although challenges such as digital access and legal restrictions persist, the integration of AI could further enhance diagnostic accuracy and care delivery. Overall, teledentistry is shaping the future of dental care, making it more accessible, preventive, and efficient.[5]

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A BRIGHTER SMILE: SUCCESSFUL LASER TEETH WHITENING - A CASE REPORT

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ABSTRACT

The application of diode laser technology in tooth whitening has shown promising results. When combined with hydrogen peroxide-based gel, this treatment approach effectively addresses tooth discoloration while ensuring patient comfort by minimising sensitivity and irritation. As a result, diode laser assisted tooth whitening is emerging as a valuable option for achieving optimal aesthetic outcomes in dentistry.

Key Words: Laser, teeth whitening, Diode

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INTRODUCTION

The introduction of new materials and technologies results in the rapid evolution of dentistry. Among these advancements lasers have revolutionised dental practice by offering a wide range of applications, from precise diagnostic procedures to intricate surgical interventions, all while ensuring minimal invasiveness and enhanced patient comfort.[1]

One notable application of lasers is laser-assisted teeth whitening, a treatment modality that is gaining popularity due to the growing importance of aesthetics in dentistry. Discoloured teeth can significantly impact an individual's self-esteem, making whitening treatments a valuable option for achieving both aesthetic and psychological benefits.[2]

The advent of laser-assisted teeth whitening marked a significant milestone in 1996, when the FDA approved the use of argon and carbon dioxide laser for this purpose. The introduction of power bleaching with lasers aimed to accelerate and enhance the whitening process. Teeth whitening with laser technology helps in controlled activation of bleaching agent, reducing the risk of thermal damage to the pulp while enhancing the overall efficacy of the treatment.[1]

In modern dental practice; Argon, potassium titanyl phosphate laser & diode lasers are frequently used for bleaching procedures. Diode lasers have a broad range of application including soft tissue surgery, periodontal therapy, endodontics, aesthetics procedures etc. Moreover, its gentle properties make it suitable for low level laser therapies.[2] When applied to teeth whitening; diode lasers have shown to safely and effectively enhance the process, staying within the critical temperature threshold of 5.5° to protect the pulp. Studies have demonstrated the effectiveness and simplicity of diode laser assisted teeth whitening; solidifying its value in dental treatments.[3]

The following case report discusses the clinical benefit of using diode laser for whitening of vital teeth.

CASE REPORT

A 30 year old female patient presented with a chief complaint of generalised discoloration of teeth and wanted to make the teeth aesthetically pleasing. Patient noticed the discolouration since 5years. Patient also reported a habit of betel nut chewing since 10years. Habit counselling was given and the patient decided to stop the habit.

During the clinical examination we noticed yellowish shade.(Fig 1) The patient reported no prior history of tooth sensitivity. During the intraoral examination, no caries or deficient mineralization of enamel were found. Various treatment options and details of the procedures were explained to the patient. Before starting the procedure shade matching of the teeth was done, in order to set a benchmark for later comparison. (Fig 2) After shade matching, the teeth were cleaned and polished using pumice paste to remove plaque.

Cheek retractor was used for better accessibility. Isolation was done using cotton wool, to maintain a dry field. After lubrication of lips, the gingival barrier (pola office plus) was

Fig 1- Pre-operative photograph

Fig 2. Shade matching using shade guide (4M 3)

applied at the level of the gingival festoon and 4mm buccal and labial surfaces and the light cured from 1cm distance. (Fig 3) The whitening agent (pola office plus) was prepared according to the manufacturer's instructions and with the help of an applicator tip, the whitening agent was applied on each tooth separately in a uniform layer. A diode laser (Pioon, 640nm) with a special whitening handpiece was used for activation. Activation was done for 20sec per quadrant at a power of 7 watts using continuous wave. After activating the gel, it will be left for 6minutes without light. After all the teeth had been exposed the whitening gel was aspirated and any remaining gel was removed using cotton pellets. The process of application of the whitening gel and laser light activation was repeated 2 times till the desired shade change is achieved. (Fig 4)The patient was advised to avoid any food or drink that cause staining and advised to report back after 2weeks to check for any reversal in tooth colour. (Fig 5)

After 14 days we recalled the patient, on examination no reversal in tooth colour was noted, and also patient had not experienced any discomfort or sensitivity after the procedure.

Fig 3- Application of gingival barrier

Fig 4- shade after bleaching(3M 2)

Fig 5- Shade jump after the procedure

DISCUSSION

Tooth discoloration is a multifaceted issue, resulting from a combination of external and internal factors. Extrinsic stains are often linked to oral hygiene and lifestyle habits, while intrinsic stains can be caused by trauma, medical conditions and certain medications. Various treatment options are available to address these stains and restore a healthy, vibrant smile.[4]

Dental professionals have developed various teeth bleaching methods. With ongoing refinements. While oxidising agents are commonly used for tooth whitening, research suggests they can potentially damage dental hard tissues, warranting cautious use. Incontrast, laser tooth whitening appears to be a more gentle approach, causing minimal changes to enamel microhardness and limited temperature increases. Laser whitening offers a time-efficient solution, producing desirable results within 1hour, making it an attractive option for those seeking quick and effective treatment.[5]

In the above reported case, we utilised a diode laser equipped with a specialised handpiece designed for tooth whitening, featuring a 6mm spot size and controlled wattage to ensure pulp safety. The Laser's ergonomic design and versatility facilitated efficient treatment.[6]

To protect the surrounding tissues, We applied a methacrylate based resin barrier that provided adequate protection and easy removal. The whitening agent used was Pola office +, prepared according to the manufacturer's instructions. Studies have shown that 38% Hygrogenperoxide activated by diode laser can significantly enhance enamel luminosity.

Fig 6- Pioon Laser Unit

Fig 6- Bleaching kit used

Fig 6- Pre and Post operative images

Notably, this peroxide gel has a basic pH, minimising the risk of surface alterations or demineralisations.[7] The diode laser accelerated the whitening process, yielding quick and effective results.[8]

Research supports the efficacy of Laser activated teeth whitening, demonstrating superior outcomes compared to stand alone whitening agents or those combined with LED sources. An added benefit of laser activation is reduced exposure time to the bleaching agents, potentially lowering the risk of sensitivity and irritation.[9]

CONCLUSION

Using diode laser for tooth bleaching is a viable treatment option as it activates the whitening agent and reduces the whitening time. It provides fast and effective tooth bleaching without causing any thermal damage. The diode laser also provides an added advantage of less or no post-operative sensitivity. Further studies should be undertaken to prove the efficacy of laser tooth bleaching.

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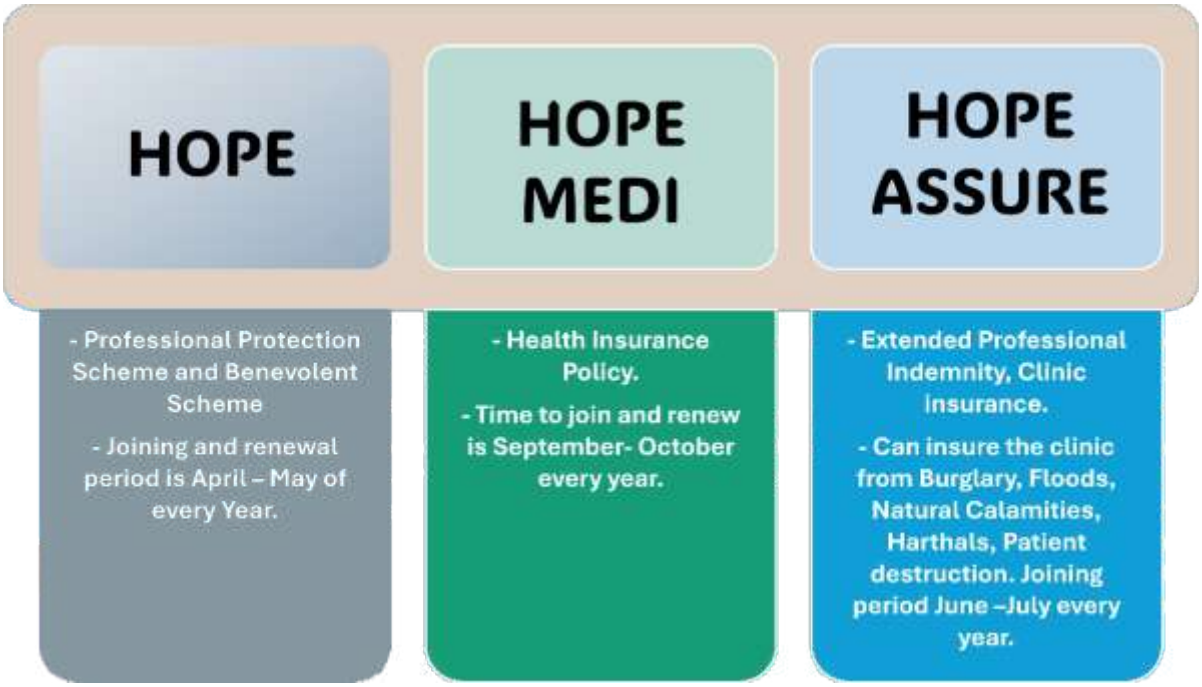

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