

EMERGING TECHNOLOGICAL TRENDS IN DENTISTRY AND ORAL HEALTH

Abstract

In this exploration of technological trends in dentistry and oral health, the abstract considers the growing influence of robotics in dental surgeries, showcasing innovations such as robot-assisted procedures and automated dental tasks. Furthermore, it discusses the advent of personalized medicine in dentistry, leveraging genetic information for tailored treatment plans. The paper also touches on the role of big data analytics in population-level oral health initiatives, aiding in the identification of patterns and trends for more effective public health strategies.

These multifaceted advancements underscore the profound impact technology is having on the entire spectrum of dental care, from individualized treatments to broader healthcare management.

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1. **Digital Dentistry:** Digital dentistry refers to the use of advanced digital technologies in various aspects of dental care, diagnosis, and treatment. It involves the integration of computerized devices and software into dental practices, replacing traditional manual methods. Digital dentistry encompasses various technologies, including digital imaging, computer-aided design and manufacturing (CAD/CAM), intraoral scanners, 3D printing, and virtual treatment planning. These technologies enhance efficiency, accuracy, and precision in dental procedures, leading to improved patient outcomes and a more streamlined dental practice.
2. **Teledentistry:** Teledentistry is a branch of telemedicine that involves the use of telecommunications technology, such as video conferencing and digital imaging, to remotely provide dental care, consultation, and education. It enables dentists to diagnose oral health issues, offer treatment recommendations, and interact with patients without requiring them to be physically present at the dental clinic.
3. **Artificial Intelligence :** Artificial Intelligence in Dentistry refers to the application of AI technologies in various aspects of dental care, diagnosis, treatment planning, and research. John McCarthy, a mathematician coined the term artificial intelligence in 1955, and widely recognized as the father of artificial intelligence. He chose this term to explain the potential of machines to perform tasks that can fall in the range of “intelligent” activities.¹

Artificial Intelligence (AI) is making significant strides in dentistry, revolutionizing various aspects of oral healthcare. Here are some key areas where AI is being utilized in dentistry:

- **Image Analysis and Diagnosis:** AI-powered algorithms can analyze dental images, such as X-rays, CT scans, and intraoral photos, to detect and diagnose dental conditions with high accuracy. AI helps identify issues like cavities, gum disease, and impacted teeth, aiding dentists in making more precise and timely diagnoses.
- **Treatment Planning:** AI assists in creating personalized treatment plans for patients. By analyzing a patient's dental history, images, and other relevant data, AI algorithms can recommend appropriate treatment options, ensuring optimal outcomes and tailored care.
- **Virtual Consultations:** Teledentistry, powered by AI-driven communication tools, allows dentists to conduct virtual consultations with patients. This enables remote diagnosis, treatment guidance, and patient education, enhancing accessibility to dental care, especially in underserved areas.
- **Natural Language Processing (NLP):** NLP enables efficient interaction between patients and dental applications. Voice-activated interfaces and virtual dental assistants can help patients schedule appointments, answer dental-related questions, and provide oral health advice.
- **Robotics in Dental Surgery:** AI-driven robotics play a role in dental surgery, assisting dentists with precise movements during procedures. Robotics can improve the accuracy of dental implant placement and other complex surgeries.
- **Predictive Analytics:** AI analyzes patient data to predict oral health trends and potential issues. Dentists can proactively address problems, such as tooth decay risk, based on the patient's unique factors, promoting preventive care.

- **Oral Cancer Detection:** AI-based algorithms can aid in the early detection of oral cancer by analyzing images of oral lesions and identifying potential signs of malignancy, leading to early intervention and improved patient outcomes.
- **Dental Education and Training:** AI-powered virtual simulations and educational tools are used to train dental students and dental professionals. These simulations offer hands-on experience and skill development in a risk-free environment.

The use of AI in dentistry continues to evolve, promising to enhance patient care, increase efficiency, and advance the field of oral healthcare. However, it's important to note that AI is not meant to replace human dentists but to augment their capabilities, leading to more effective and comprehensive dental care.

4. Nanotechnology: Nanotechnology in dentistry involves the application of nanomaterials and nanoscale science to address various oral health challenges. Nanotechnology enables the manipulation and control of materials at the nanometer scale, which is exceptionally small, typically ranging from 1 to 100 nanometers. This technology has opened up new possibilities in dental research, diagnosis, treatment, and preventive care. Here are some key areas where nanotechnology is being utilized in dentistry:

- **Dental Restorations:** Nanomaterials are used in dental fillings, crowns, and dental composites. Nanocomposites offer improved mechanical properties, better aesthetics, and enhanced wear resistance, resulting in longer-lasting and stronger dental restorations.
- **Dental Implants:** Nanotechnology plays a role in enhancing the surface properties of dental implants. Nanostructured coatings can promote better osseointegration, leading to more successful and faster implant integration with the surrounding bone tissue.
- **Dental Adhesives:** Nanotechnology has led to the development of adhesive systems with improved bonding strength. Nanoparticles incorporated into dental adhesives enhance their adhesion to tooth structure, contributing to more durable and reliable restorations.
- **Oral Drug Delivery:** Nanoparticles are utilized in oral drug delivery systems, enabling targeted and controlled release of therapeutic agents. This approach can improve the effectiveness of antimicrobial agents, pain relief medications, and other treatments for oral diseases.
- **Bioactive Materials:** Nanotechnology allows the incorporation of bioactive agents, such as antimicrobial agents and remineralizing agents, into dental materials. This helps prevent tooth decay and promotes the remineralization of damaged tooth enamel.
- **Diagnostics:** Nanoscale diagnostic tools are being developed to detect oral diseases at an early stage. Nanosensors and nanoprobes can identify biomarkers associated with oral health conditions, enabling quicker and more accurate diagnoses.
- **Oral Care Products:** Nanotechnology has influenced the development of advanced oral care products, such as toothpaste and mouthwashes. Nano-sized ingredients can enhance the efficacy of these products in maintaining oral health and preventing dental problems.
- **Tissue Engineering:** Nanotechnology contributes to tissue engineering approaches for regenerating damaged oral tissues. Nanomaterials are used to create scaffolds that

support tissue growth and regeneration in cases of periodontal disease or oral tissue defects.

The integration of nanotechnology in dentistry holds great potential to improve dental treatments, enhance patient outcomes, and promote better oral health. However, ongoing research and safety assessments are essential to ensure the long-term effectiveness and safety of nanomaterials used in dental applications.

5. Augmented Reality (AR) and Virtual Reality (VR): Augmented Reality (AR) and Virtual Reality (VR) are immersive technologies that are increasingly finding applications in dentistry, transforming the way dental care is delivered and experienced. Here's how AR and VR are utilized in dentistry:

- **Dental Education and Training:** AR and VR are used to create interactive and realistic simulations for dental students and practitioners. Dental students can practice procedures in a virtual environment, gaining hands-on experience without the need for real patients. This technology enhances training and skill development in a safe and controlled setting.
- **Treatment Planning:** AR and VR allow dentists to visualize and plan complex dental procedures with greater precision. Dentists can overlay digital models and treatment plans onto a patient's real-time oral anatomy, aiding in accurate treatment planning and execution.
- **Patient Education:** AR and VR provide patients with a better understanding of their oral health conditions and proposed treatments. Dentists can use these technologies to show patients visual representations of their dental issues, treatment options, and expected outcomes, leading to more informed decision-making.
- **Dental Implant Placement:** AR and VR assist in precise dental implant placement. Dentists can use virtual guides and overlays to determine the optimal position for dental implants based on the patient's specific anatomy.
- **Dental Anxiety Management:** AR and VR can be used as a distraction technique to reduce dental anxiety in patients. Immersive experiences can help patients relax during procedures, making the dental visit more comfortable.
- **Virtual Consultations:** AR and VR enable virtual consultations between dentists and patients. Patients can interact with dentists remotely, discussing treatment options and receiving expert advice without physically visiting the dental clinic.
- **Digital Smile Design:** AR and VR tools allow dentists to create virtual smile designs for cosmetic dental procedures. Patients can preview potential smile makeovers, providing them with a visual representation of the final result before committing to the treatment.
- **Prosthodontics and Orthodontics:** AR and VR assist in the fabrication and fitting of dental prosthetics and orthodontic appliances. Dentists can use these technologies to design and customize dental restorations, aligners, and retainers.

The integration of AR and VR in dentistry enhances patient care, improves treatment outcomes, and enhances the overall dental experience for both patients and dental professionals. As these technologies continue to advance, they hold the potential to revolutionize dental practice and contribute to better oral health outcomes.

- 6. Laser Dentistry:** Laser dentistry is an innovative and minimally invasive approach to performing various dental procedures using dental lasers. These lasers produce a focused, intense beam of light that can be precisely directed to target specific areas in the mouth. Laser technology has gained popularity in dentistry due to its numerous benefits, including:
- **Precision:** Dental lasers allow dentists to target specific tissues accurately, minimizing damage to surrounding healthy tissues.
 - **Minimally Invasive:** Laser procedures often require less cutting and suturing compared to traditional methods, leading to reduced discomfort and faster healing for patients.
 - **Reduced Bleeding:** The laser's cauterizing effect promotes blood clot formation, reducing bleeding during and after procedures.
 - **Anesthesia Reduction:** In some cases, laser dentistry may reduce the need for local anesthesia, making the dental experience more comfortable for patients.
 - **Faster Healing:** Laser procedures can stimulate tissue regeneration, leading to faster healing and reduced post-operative discomfort.
 - **Bacterial Reduction:** Some dental lasers have antimicrobial properties, helping to disinfect the treatment area and reduce the risk of infection.

Laser dentistry finds applications in various dental procedures, including:

- **Treatment of Gum Disease:** Dental lasers can be used to remove infected gum tissue and bacteria during periodontal treatments.
- **Tooth Decay Removal:** Lasers can precisely remove decayed portions of the tooth, preparing it for dental fillings.
- **Gum Reshaping:** Lasers can reshape excessive gum tissue to improve the appearance of a "gummy smile."
- **Biopsies:** Dental lasers can be used to perform oral tissue biopsies for diagnostic purposes.
- **Soft Tissue Surgeries:** Lasers can assist in various soft tissue surgeries, such as frenectomies and aphthous ulcer treatment.

While laser dentistry offers numerous advantages, its implementation may depend on the specific dental practice and the expertise of the dental professional. Not all dental procedures can be performed using lasers, and traditional methods may still be preferred in certain cases. However, the continuous advancements in laser technology are expanding the scope of laser dentistry and its potential benefits for both patients and dental practitioners.

- 7. 3D Printing:** 3D printing, also known as additive manufacturing, has become a game-changer in dentistry, revolutionizing various aspects of dental care and treatment. 3D printing technology allows the creation of precise and customized dental structures, restorations, and appliances based on digital data. Here are some key applications of 3D printing in dentistry:
- **Dental Restorations:** 3D printing enables the fabrication of dental crowns, bridges, and veneers with exceptional accuracy and fit. Using digital scans of a patient's

mouth, 3D printers can produce restorations that match the patient's natural teeth in color, shape, and size.

- **Dental Implants:** 3D printing is used to create surgical guides for dental implant placement. These guides assist dentists in precise implant positioning, resulting in improved success rates and reduced surgical complications.
- **Orthodontic Aligners:** 3D printing technology is widely used in orthodontics to produce clear aligners for teeth straightening. Customized aligners are designed based on digital scans and treatment plans, allowing for more efficient and comfortable orthodontic treatments.
- **Removable Dentures:** 3D printing can produce accurate and well-fitting removable dentures, making the process more efficient and cost-effective compared to traditional methods.
- **Surgical Models and Guides:** 3D printing enables the creation of patient-specific surgical models and guides, helping dentists plan and execute complex procedures with greater precision and efficiency.
- **Temporomandibular Joint (TMJ) Disorders:** 3D printing is used to create custom TMJ splints and oral appliances to alleviate symptoms associated with TMJ disorders.
- **Craniofacial Reconstruction:** 3D printing plays a crucial role in craniofacial reconstruction for patients with congenital or acquired facial deformities. It allows for personalized implants that closely match the patient's anatomy.
- **Educational Models:** 3D printing is utilized in dental education to create anatomically accurate models for hands-on training and learning.

The benefits of 3D printing in dentistry include improved treatment accuracy, reduced treatment time, better patient outcomes, and enhanced patient satisfaction. By leveraging this technology, dental professionals can deliver highly customized and efficient care to their patients, advancing the field of dentistry into the era of digital dentistry.

8. Robotics in Dentistry: Robotics in dentistry involves the integration of robotic technology to assist dental professionals in performing various dental procedures. Dental robotics aim to enhance precision, efficiency, and patient outcomes, while also reducing the physical strain on dentists during repetitive tasks. Here are some ways robotics are utilized in dentistry:

- **Dental Implant Surgery:** Robotic systems can assist dentists in the precise placement of dental implants. These robots use pre-operative 3D scans to guide the implant placement, ensuring accurate positioning and improved osseointegration.
- **Endodontic Procedures:** Robotics can be used to perform root canal treatments with high precision. Robotic instruments can navigate complex root canal systems, leading to better cleaning and shaping of the root canals.
- **Tooth Preparation:** Robots can assist in the preparation of teeth for dental restorations, such as dental crowns. They can precisely shape the tooth to ensure an optimal fit for the restoration.
- **Dental Prosthodontics:** Robotics can aid in the fabrication of dental prosthetics, including crowns, bridges, and dentures. They can mill restorations with high accuracy based on digital scans.

- **Orthodontic Procedures:** Robotic systems can assist in the precise bending and shaping of orthodontic archwires, contributing to more efficient and effective orthodontic treatments.
- **Teeth Whitening:** Robots can apply teeth whitening agents with consistent pressure and motion, resulting in more uniform and controlled teeth whitening procedures.
- **Patient Assistance and Comfort:** Social robots can be used to interact with patients, providing them with information about treatments, offering comfort during procedures, and reducing dental anxiety.

It's important to note that while dental robotics offer several benefits, they are typically used as an aid to dental professionals rather than completely replacing human dentists. The human dentist remains in control of the robotic system, making clinical decisions and ensuring patient safety.

The development of dental robotics is an ongoing area of research and innovation, and as technology advances, it is likely to play an increasingly significant role in improving dental treatments and patient care.

9. Virtual Treatment Planning: Virtual treatment planning software allows dentists to visualize and plan complex dental surgeries and restorative procedures in a digital environment, enhancing treatment outcomes.

10. Bioprinting: Bioprinting in dentistry is an emerging field that combines the principles of 3D printing with tissue engineering to create living biological structures for dental applications. It involves the precise deposition of bioink, a biocompatible material containing living cells, to fabricate complex dental tissues and structures. Bioprinting has the potential to revolutionize the way dental treatments are approached and has several promising applications:

- **Bioengineered Dental Tissues:** Bioprinting can be used to create bioengineered dental tissues, such as tooth enamel, dentin, and cementum. This technology may eventually lead to the development of fully functional teeth for patients in need of tooth replacement.
- **Gum Tissue Regeneration:** Bioprinting allows for the fabrication of 3D gum tissue scaffolds containing living cells. These scaffolds can be used to promote the regeneration of gum tissue in cases of periodontal disease or gum recession.
- **Salivary Gland Regeneration:** Bioprinting techniques can be employed to create bioengineered salivary glands for patients with salivary gland dysfunction, improving oral health and comfort.
- **Dental Pulp Regeneration:** Bioprinting offers a promising approach to regenerate dental pulp tissue, potentially providing an alternative to traditional root canal treatments.
- **Customized Dental Implants:** Bioprinting can be used to create patient-specific dental implants with built-in bioactive factors to promote better integration with the surrounding bone and soft tissues.
- **Drug Delivery Systems:** Bioprinting can produce 3D-printed drug delivery systems for targeted and controlled release of therapeutic agents in the oral cavity, aiding in the treatment of oral diseases.

While bioprinting in dentistry shows great potential, it is still in the early stages of development. Researchers are actively exploring different bioink formulations, optimizing printing techniques, and addressing regulatory challenges to ensure the safety and efficacy of bioprinted dental structures. As the technology advances, bioprinting has the potential to significantly impact dental care, providing innovative solutions for personalized and regenerative dental treatments.

- 11. Wearable Oral Health Devices:** Wearable devices like smart mouthguards and oral health trackers are being developed to monitor dental health metrics, detect dental issues early, and improve patient compliance with treatment plans.
- 12. Internet of Things (IoT) Integration:** Dental clinics are incorporating IoT devices to automate patient records, track equipment maintenance, and streamline administrative tasks for improved efficiency.
- 13. Dental Nanorobots:** The concept of dental nanorobots involves miniature robotic devices capable of performing precise tasks, such as targeted drug delivery or plaque removal.
- 14. Blockchain for Dental Records:** Blockchain technology is explored to secure and share dental records, ensuring patient data privacy and facilitating interoperability between healthcare providers.
- 15. Virtual Reality Sedation:** Virtual reality is being studied as a non-pharmacological sedation method to help alleviate dental anxiety during procedures.
- 16. Artificial Intelligence for Oral Cancer Detection:** AI algorithms are being developed to analyze oral images and detect early signs of oral cancer, potentially improving diagnosis and treatment outcomes.
- 17. Gamification of Oral Healthcare:** Mobile apps and games are being designed to make oral care routines more engaging for children and encourage better dental hygiene habits.
- 18. Dental Education through E-Learning:** Online platforms and virtual courses are becoming more popular for dental education, enabling professionals to access continuous learning and updates conveniently.
- 19. Smart Dental Treatment Mirrors:** Innovative mirrors equipped with cameras and sensors aid dentists in obtaining clearer views during treatments and allow patients to visualize their dental conditions better.
- 20. Biodegradable Dental Materials:** Researchers are working on developing biodegradable dental materials that can promote tissue regeneration and reduce the need for multiple dental interventions.
- 21. Oral Health Apps for Virtual Consultations:** Mobile apps and platforms are enabling patients to connect with dentists for virtual consultations, follow-ups, and oral health advice, enhancing convenience and accessibility to dental care.

- 22. Cone Beam Computed Tomography (CBCT):** CBCT imaging provides detailed 3D views of the oral and maxillofacial structures, aiding in precise diagnosis and treatment planning for complex dental cases.
- 23. Digital Smile Design (DSD):** DSD software allows dentists to digitally design a patient's ideal smile, facilitating better communication between the dentist and the patient for cosmetic dental treatments.
- 24. Real-Time Chairside CAD/CAM Restorations:** Chairside CAD/CAM systems enable dentists to create and place restorations (e.g., crowns, veneers) in a single appointment, reducing treatment time and the need for temporary restorations.
- 25. Smart Dental Materials:** Advances in smart materials with properties like self-healing, antimicrobial effects, and sensitivity to dental caries are being researched for enhanced preventive and restorative treatments.
- 26. Salivary Diagnostics:** Saliva-based diagnostic tests are being explored for early detection of various oral and systemic health conditions, offering a non-invasive and cost-effective approach to screening.
- 27. Augmented Intelligence in Dental Practice Management:** Augmented intelligence tools are assisting dental practices with tasks like appointment scheduling, billing, and inventory management, optimizing workflow efficiency.
- 28. Regenerative Dentistry:** Research in regenerative therapies involves using stem cells and growth factors to repair and regenerate damaged oral tissues, potentially revolutionizing dental treatments.
- 29. Virtual Reality Dental Training Simulators:** Virtual reality training simulators are used to improve dental students' and practitioners' skills, providing a risk-free environment for practicing various procedures.
- 30. Dental Micro-robots:** Micro-robots are being explored for tasks like plaque removal, targeted drug delivery, and minimally invasive dental surgeries.
- 31. Ultrasonic and Photodynamic Therapies:** Ultrasonic devices and photodynamic therapies are being employed for non-surgical treatment of gum disease and oral infections.
- 32. Social Robotics for Dental Anxiety Management:** Social robots equipped with interactive capabilities are studied for reducing dental anxiety and creating a more relaxed atmosphere during dental visits.
- 33. Energy-based Devices for Tissue Healing:** Energy-based devices, such as low-level laser therapy and photobiomodulation, are used to promote tissue healing, reduce inflammation, and manage pain in dental procedures.

- 34. 3D Oral Scanners for Orthodontic Treatment:** Intraoral scanners are utilized in orthodontics to create digital models for designing clear aligners, enhancing the precision and efficiency of orthodontic treatments.
- 35. Dental Data Analytics:** Data analytics tools are employed to analyze large datasets, providing valuable insights for improved treatment planning, patient outcomes, and oral health research.
- 36. Smart Dental Flossers and Interdental Brushes:** IoT-enabled flossers and interdental brushes help individuals maintain proper oral hygiene between dental visits, with features like tracking usage and providing feedback.
- 37. Virtual Reality for Pain Management:** Virtual reality is explored as a distraction technique during dental procedures, helping patients manage pain and anxiety more effectively.
- 38. Dental Artificial Intelligence Assistants:** AI-powered virtual assistants are being developed to aid dentists in tasks like patient communication, appointment scheduling, and treatment plan reminders.
- 38. Wireless Dental Sensors:** Wireless sensor technology allows for real-time monitoring of dental implants, orthodontic appliances, and other oral devices, facilitating proactive management and timely interventions.
- 39. Robotic Dental Assistants:** Dental robotic assistants are designed to assist dentists during procedures, ensuring efficiency and precision in various tasks.
- 40. Smart Orthodontic Devices:** IoT-based orthodontic devices, such as smart braces or aligners, can track treatment progress, offer personalized feedback, and enable remote monitoring by orthodontists.
- 41. Telemedicine for Dental Specialists:** Telemedicine platforms connect general dentists with dental specialists for remote consultations and collaborative treatment planning.
- 42. AI-Powered Smile Analysis:** AI algorithms are utilized to analyze facial features and propose personalized smile designs for cosmetic dental procedures.
- 43. Nanobots for Biofilm Removal:** Nanorobots capable of targeting and removing oral biofilms are being researched to combat dental plaque and prevent oral diseases.
- 44. Holographic Imaging for Surgical Guidance:** Holographic displays are explored for providing dentists with real-time, interactive 3D guidance during complex dental surgeries.
- 45. Dental Insurance and Billing Apps:** Mobile apps are being developed to simplify dental insurance processes, claims filing, and transparent billing for patients.
- 46. Voice-Activated Dental Devices:** Voice recognition technology allows for hands-free operation of dental devices, making them more convenient for both patients and dental professionals.

- 47. Dental Health Monitoring Wearables:** Wearable devices equipped with sensors can monitor factors like teeth grinding, jaw movements, and sleep patterns to identify potential dental issues.
- 48. AI-Powered Oral Health Chatbots:** AI chatbots assist users in answering oral health questions, providing oral hygiene tips, and offering guidance on dental emergencies.
- 49. Photodynamic Therapy for Teeth Whitening:** Photodynamic therapy is explored as a gentle and efficient method for teeth whitening with the help of light-activated agents.
- 50. Personalized Nutrition for Oral Health:** Genetic testing and AI-driven analysis enable personalized dietary recommendations that can positively impact oral health and prevent dental issues.
- 51. Mobile Dental Clinics:** Mobile dental clinics equipped with state-of-the-art technology bring oral healthcare to underserved communities, schools, and remote areas.
- 52. Digital Occlusion Analysis:** Digital tools help dentists assess and analyze occlusion (bite) patterns more accurately, aiding in the diagnosis and treatment of occlusal disorders.
- 53. Dental Implant Innovations:** Advancements in materials and techniques have improved dental implant procedures, making them more predictable, durable, and minimally invasive.
- 54. 3D-Printed Biocompatible Dental Prosthetics:** Advanced 3D printing techniques allow for the creation of biocompatible, patient-specific dental prosthetics, improving patient comfort and function.
- 55. Dental Practice Management Software Integration:** Dental practice management software integrates with various digital tools, streamlining administrative tasks and enhancing patient engagement.
- 56. AI-Powered Cavity Detection:** AI algorithms can aid in early detection of cavities from dental images, enabling timely intervention and preventive measures.
- 57. Biocompatible Materials:** Dental materials that are more biocompatible and promote natural tissue regeneration are gaining popularity for restorations and treatments.
- 58. Personalized Dentistry:** Advances in genetic testing and personalized medicine are influencing dental treatment approaches, tailoring care to individual patients' needs.
- 59. Smart Toothbrushes and Oral Health Apps:** IoT devices like smart toothbrushes and oral health apps are helping people monitor their oral hygiene habits and providing feedback for better oral health management.

These ongoing technological trends demonstrate the continuous efforts to advance dental care, promote oral health, and provide innovative solutions to meet the evolving

needs of patients and dental professionals alike. As the field of dentistry continues to embrace technological advancements, these trends are expected to shape the future of oral healthcare, offering innovative solutions for both dental professionals and patients. These trends represent ongoing efforts to improve dental care, enhance patient experiences, and leverage cutting-edge technologies to address various oral health challenges. As technology continues to advance, the field of dentistry is likely to see even more exciting developments in the future.

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