

Evolving Dental Care Protocols for Precision and Personalized Oral Health for Epileptic Patients

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Abstract—Epilepsy, is a chronic neurological disorder affecting millions of people worldwide. This creates complex situations especially for providing dental care. The seizures are unpredictable, affected by long-term antiepileptic medications add severe complications during invasive procedures. Established procedures in dentistry have mainly focused on broad-based strategies. This involves reducing stress, being prepared for emergency situations, and taking necessary steps to prevent seizures. They often fail to account for the differences among the patients. These includes the variations in seizure type and frequency with the differences in how medications are metabolized. If other health conditions occurs with epilepsy then the impact on the patient. In recent years, dental care has started moving towards a more precise and personalized approach, where treatment plans are tailored to each patient's medical history and individual risk factors. New tools such as artificial intelligence-based systems for predicting seizures, wearable devices for continuous monitoring, customized sedation plans, and pharmacogenomic guidance for choosing the right medications are helping improve both safety and treatment effectiveness. At the same time, advancements like digital workflows, minimally invasive treatment techniques, and tele-dentistry are making specialized dental services more accessible, especially in areas where epilepsy care was previously limited. This review summarizes current global guidelines, highlights new evidence-based approaches, and discusses emerging technologies with the aim of creating a clear roadmap to improve safety, personalization and long-term outcomes in dental care for people with epilepsy.

Index Terms—Antiepileptic drugs, Dental management, Epilepsy, Personalized oral healthcare, Precision dentistry, Sedation, Tele-dentistry.

I. INTRODUCTION

Epilepsy is a medical condition that lasts a long time and causes people to have seizures because their brain is not working normally for short times. More than 50

million people have epilepsy all over the world. The challenge is even bigger in developing countries, where it can be tough to get special medical or dental care. Children are especially affected, and Rolandic epilepsy is common in kids, which makes dental care more difficult.

Epilepsy's effect on dental health goes beyond just the seizures. People with epilepsy can hurt their mouth during a seizure. These injuries might be cuts on the tongue or cheek, broken teeth, or even a dislocated jaw. The medicines used for epilepsy—like phenytoin, carbamazepine, and sodium valproate—can cause problems too. These medicines might make gums grow over the teeth, cause dry mouth, sores, and slow down new teeth coming in. These problems get worse when patients and their families do not know much about them or because there are less resources or training for dentists. As a result, people with epilepsy often have fewer teeth fixed or replaced compared to others.

In the past, dental care for people with epilepsy meant trying to stop seizures, reducing stress, and being prepared for emergencies. These are important for basic safety, but they aren't designed for each person's needs. Differences like kinds of seizures a person has, their other health problems, or how they respond to medicine are often not considered in old methods. Over time, reports and research have shown that the same plan for everyone is not always safe or best.

Lately, there has been a shift towards dental care that fits the person. For example, appointments can be scheduled when the risk of seizures is lowest, or dentists may pick anesthetics carefully to avoid problems with epilepsy drugs. They also often recommend fixed dental replacements over removable ones to lower choking risks. New technology—like

digital tools, seizure monitors, AI to predict seizures, and tests based on genetics—is helping make care more centered on each patient. Tele-dentistry and better teamwork with neurologists is also making dental treatments more personal and effective.

This review brings together older dental care methods and the latest science and technology. It compares old and new standards and digital tools. The main goal is to give a clear and current summary: to show how dental care for epilepsy patients is changing to be safer, more personal, and better in the long term.

II. METHODOLOGY

To really understand how people with epilepsy are managed by dentists and how new, fine-tuned methods are being used, researchers searched literature in medical databases like PubMed, Scopus, Web of Science, Cochrane Library, and Google Scholar for articles published between 2000 and 2025. They used keywords such as “epilepsy and dentistry,” “dental management of seizure disorders,” “antiepileptic drugs and oral health,” “precision dentistry in epilepsy,” “personalized oral healthcare in epilepsy,” and “tele-dentistry for special needs patients.”

Different types of research were included—original studies, reviews, meta-analyses, clinical guides, and patient case reports that talked about dental care for epilepsy. Works were chosen if they described dental signs of epilepsy, side effects from epilepsy drugs in the mouth, ways to handle seizure risk during dental care, or new things like genetics, sedation, or digital dentistry methods. To keep things clear, only English articles were included.

Studies were excluded if they were not in English, did not relate to dental or oral health care, or focused only on neurological or surgical aspects without relevance to dental practice. Papers without full-text access or those offering only opinions without scientific data were also excluded.

The initial search found about 120 articles. After removing duplicates and reviewing abstracts, 52 full-text articles were obtained. Of these, 36 studies were finally included in the review. These included

landmark works by Aragon and Burneo, Jacobsen and Eden, and Yaltırık et al., as well as more recent case reports such as Fatani et al. Reviews by Singh and by Nirmala and Degala provided important insights into pediatric and preventive aspects.

The selected studies were then analyzed by grouping them into key themes: risk assessment and patient classification, drug interactions and medication management, anesthesia and sedation approaches, restorative and prosthodontic planning, trauma prevention, digital and tele-dentistry use, and the role of precision and personalized dentistry. This thematic analysis helped combine traditional dental practices with new, advanced approaches into a clear and practical framework for clinical application.

III. EMERGING TRENDS IN DENTAL CARE FOR EPILEPTIC PATIENTS

3.1 Risk Assessment and Patient Stratification

Effective dental care for a patient with epilepsy starts with carefully reviewing their medical and seizure history. Important details include how often seizures occur and what type they are with their triggering factors. With understanding of these factors dentist plans treatment that suits the patient’s needs. Scheduling appointments at times when seizure are less likely to happen.[1], [9], [10], [11]. Making small changes to dental clinic’s environment can improve the safety for patients with epilepsy. These include reducing the bright lights and lowering background noise with keeping the appointments shorter. Neurologists can provide medical clearance and details about the patient’s seizure history before major dental treatments. This will ensure the dental team to prepare for both routine care and possible emergency situations.[9], [11], [14], [15].

3.2 Seizure Prediction and AI-Assisted Monitoring

The artificial intelligence (AI) is revolutionizing the approaches for the dental experts to predict and manage the treatment of patients with epilepsy. In the past, dentists mainly depended on patient history and observation, but now seizure-detection devices and AI tools can give real-time information about the chances of a seizure happening. In the future, these systems might even be connected to dental chairs, sending alerts that help the dentist pause or adjust the treatment

before a seizure starts. Although these technologies are still new, they are an important step toward making dental care safer and more personalized for patients with epilepsy. [16].

3.3 Pharmacological and Drug-Interaction Protocols

Older drugs like phenytoin, carbamazepine, sodium valproate, and phenobarbital can cause several oral problems. These include gum overgrowth with dry mouth, mouth ulcers, and delayed tooth eruption. Newer AEDs, like lamotrigine and levetiracetam causes fewer oral side effects. These drugs can still lead to skin reactions and interact with other medications. [4], [5], [6], [8], [15].

3.4 Sedation and Anesthesia Guidelines

Some patients with epilepsy may need sedation during dental treatment due to anxiety. Carefully controlled doses of benzodiazepines is generally considered safe in the treatment. General anesthesia is used only for patients who have uncontrolled seizures. Local anesthetics are also safe when given in proper doses. Overdosing of local anesthetics can trigger seizures. Nowadays, the focus is on using patient-specific sedation plans that are carefully adjusted to reduce the risk of seizures while keeping the patient comfortable and ensuring the procedure goes smoothly. [5], [9], [11], [18]. This personalized approach underscores the importance of monitoring and tailoring pharmacological choices to the individual's medical background [14].

3.5 Restorative, Prosthodontic, and Orthodontic Advances

Because epileptic seizures increase the risk of oral trauma, prosthetic and restorative decisions must be made carefully. Fixed prostheses, implant-supported restorations, and reinforced composite materials are generally preferred over removable appliances and fragile ceramics, which may fracture or become dislodged during a seizure. Orthodontic appliances should be securely fixed and designed to reduce aspiration risk [4], [17]. The introduction of computer-aided design and manufacturing (CAD/CAM) and three-dimensional printing technologies allows the creation of restorations that are stronger, more durable, and personalized to the patient's unique risk profile,

improving both function and long-term safety [16], [17].

3.6 Preventive and Behavioral Approaches

Patients with epilepsy often have poor oral hygiene and a higher risk of dental caries, partly because of the sugar-based liquid forms of antiepileptic drugs (AEDs) they take and the dry mouth (xerostomia) these medicines can cause. Preventive care, such as regular dental cleanings, fluoride treatments, and counseling for parents or caregivers in children's cases, is important to reduce oral diseases. Using stress reduction techniques, providing behavioral support, and keeping dental visits short and predictable can also help lower the chances of triggering a seizure during treatment. [2], [3], [9], [10].

3.7 Digital Dentistry and Tele-Dentistry Integration

Tele-dentistry has become increasingly important, especially for high-risk patients who find it difficult to visit the dental clinic regularly. Through virtual consultations, dentists can check oral hygiene habits, monitor side effects of antiepileptic drug (AED) treatment, and give advice on preventive care. Combining digital dental records with wearable seizure monitors and AI-based alerts points to a future where remote monitoring and in-clinic treatment work together smoothly, improving both patient safety and access to dental care. [6], [16].

IV. CHALLENGES AND LIMITATIONS

Although there has been significant progress in improving dental care for people with epilepsy, several barriers still limit the wide use of precision and personalized treatment approaches. These barriers include clinical, technological, educational, and social factors.

4.1 Lack of Standardized Global Protocols

There are many guidelines and recommendations for dental care in epilepsy, but no single worldwide standard. This means there are big differences in sedation, drug choices, and how teeth are replaced. Such variety sometimes puts patient safety at risk and leads to mixed results, especially when many doctors must work together [4], [5], [6].

4.2 Drug-Related Oral Complications

Some drugs can make gums grow too much causing dry mouth, bleeding, and other issues of significance.

For example, phenytoin, if used for a long time. Even merely treating the gums may not always help. Dentists must also understand the mechanism regarding how epilepsy medicines interact with drugs, such as, antibiotics or painkillers, which may sometimes make seizures worse [4], [5], [6], [8], [15].

4.3 Risk of Seizures During Dental Care

One of the biggest problems is that the seizures can occur without warning, during the dental procedure or treatment. Even with strategies to lower stress, a seizure may still happen in the dental chair. This risk often makes dentists keep visits short, avoid complicated treatments, or even refuse care for some patients [9], [11].

4.4 Limited Adoption of Precision Technologies

Tools like AI to predict seizures, wearable monitors, and genetic tests aren't commonly used yet. This is because of costs, technology limits, lack of wide research, and concerns over privacy and fairness. In addition, ethical issues and practices such as patient data privacy, informed consent, and fair access to these tools also delay in the adoption and practice of such interventions into regular dental care [16].

4.5 Training and Awareness Gaps Among Dentists

Many studies show that a large number of dentists are not confident about caring for epilepsy patients, especially during emergencies or when medicines interact badly. Without better education and training, these patients could have lower access to proper dental care in receiving the same quality of dental care as other patients. [6], [10], [15].

4.6 Psychosocial and Access Barriers

Outside the clinical setting, patients with epilepsy often face social and emotional challenges worsening their oral health. Fear of having a seizure during a dental visit, financial problems, stigma related to the condition, and lack of family support often leads to delayed dental care and poor oral hygiene. In children, misunderstandings about dental treatment and parental anxiety can further limit access to preventive and restorative services. Together, these factors result in greater overall treatment needs and higher rates of untreated dental problems [7], [12].

V. FUTURE PROSPECTS

The management of epileptic patients in dentistry is gradually shifting from broad, generalized guidelines to highly individualized and precision-based care. Emerging technologies and interdisciplinary approaches are likely to reshape the way dental practitioners assess risks, plan treatments, and deliver long-term oral healthcare.

5.1 Integration of Genomics and Pharmacogenetics

As genetic testing becoming more widely available, pharmacogenomics is expected to play an important role in personalizing antiepileptic drug therapy. By identifying individual differences in how patients process medications and how their tissues respond, clinicians can predict who is more likely to develop side effects such as gum overgrowth, bleeding, or delayed healing. This personalized approach can help reduce drug-related problems and allow dental treatment plans to be better tailored to each patient's unique genetic makeup [16].

5.2 AI-Enabled Seizure Monitoring in Dental Settings

Artificial intelligence (AI) is expected to turn seizure prediction from a theoretical concept into a useful tool in dental clinics. In the future, machine learning systems built into dental chairs and monitoring devices may give real-time alerts when a patient's seizure risk increases. This would allow dentists to pause treatment, take preventive steps, or start emergency procedures in advance, helping to reduce complications during dental care and improve patient safety [16].

5.3 Seizure-Resistant Prosthetic and Restorative Materials

New advancements in material science and digital dentistry are helping create dental restorations and prostheses that are better suited for patients with epilepsy. CAD/CAM technology and 3D printing allow the production of strong, fracture-resistant restorations that are less likely to break during seizures. The development of flexible and biocompatible materials can further lower the risk of aspiration and improve both the strength and safety of prosthetic treatments. [17].

5.4 Personalized Sedation and Anesthesia Protocols

Future sedation methods are expected to become more personalized and supported by artificial intelligence (AI). By using information such as a patient's seizure history, genetic data, and real-time body monitoring, dentists could create sedation plans that effectively reduce anxiety without increasing the risk of seizures. This individualized approach would improve both patient comfort and the safety of dental procedures [11], [18].

5.5 Digital and Remote Care Ecosystems

Tele-dentistry is developing from basic online consultations into a complete system for remote dental care. In the future, wearable seizure-detection devices could be linked with tele-dentistry platforms, allowing neurologists and dentists to work together in managing patient care. This approach could help plan personalized follow-up visits, monitor oral health changes remotely, and improve emergency preparedness, providing continuous support for high-risk patients [6], [16].

5.6 Education and Simulation-Based Training

Improving dentist training through simulation exercises and interdisciplinary workshops is another important future step. By learning to manage drug interactions, and working closely with neurologists, the dental professionals can build the confidence and skills needed to provide safe and effective care for patients with epilepsy and carefully practice to handle seizure emergencies [10], [15].

5.7 Ethical, Regulatory, and Policy Frameworks

Finally, as technologies like AI, genomics, and tele-health become part of regular dental practice, creating clear international guidelines will be essential. Ethical issues such as informed consent, data privacy, equal access, and responsible use of patient data must be carefully addressed to make sure these technologies benefit patients without increasing inequalities. Global policies will play a key role in ensuring the safe, ethical, and widespread use of precision dentistry for patients with epilepsy.7], [16].

VI. CONCLUSION

Patients with epilepsy are a special and vulnerable group in dental care, as their treatment must consider both the unpredictable nature of seizures and the oral problems caused by long-term antiepileptic drug use.

Traditional approaches, such as reducing stress, preparing for seizures, and having emergency plans, provide a basic level of safety but often do not account for differences in seizure patterns, drug effects, and other health conditions among patients.

Recent studies and case reports show that personalized care — planned together with neurologists and tailored to each patient's medical history — can lead to better treatment outcomes and improved safety [9], [11]. Examples of patient-centered care include scheduling dental visits at times when seizures are less likely, choosing restorative materials that can resist trauma, and using fixed prostheses instead of removable ones.

AI-based seizure prediction, drug selection guided by pharmacogenomics, strong digital prosthetics designed to withstand seizures, and integrated tele-dentistry systems are expected to shift dental care from a reactive approach to a more proactive one. It is also important to develop global guidelines, improve dentist training, and ensure fair access so that these advancements can benefit patients in all types of healthcare settings. In the future, the use of precision tools is expected to further improve.6], [16], [17]. [7], [16].

Ultimately, the future of dental management for epileptic patients lies in bridging traditional safety measures with modern precision-based innovations. By combining clinical vigilance with technological advancement, dentistry can move closer to a model of personalized oral healthcare. This will prioritize both safety and quality of life for people living with epilepsy [11], [17].

Summary Table: Emerging Trends in Dental Care for Epileptic Patients

Domain	Emerging Trend	Benefit for Epileptic Patients
Risk Assessment	Stratification based on seizure history, triggers, and comorbidities [1], [9]-[11], [15]	Enables safer scheduling and reduces intraoperative seizure risk [9], [11]
Seizure Monitoring	AI-assisted wearables and integration with dental chair systems [16]	Provides early warning signals and allows proactive intervention [16]
Pharmacological Care	Pharmacogenomic-guided AED selection and drug monitoring [4]-[6], [8], [15]	Minimizes gingival overgrowth, bleeding tendencies, and xerostomia [4], [5], [8]
Sedation & Anesthesia	Personalized sedation titration using nitrous oxide/benzodiazepines [5], [9], [11], [18]	Reduces seizure provocation and ensures safer procedural outcomes [11], [18]
Restorative/Prosthodontic	CAD/CAM restorations, implant-supported prostheses, seizure-resistant materials [4], [17]	Lowers risk of fracture, aspiration, and displacement during seizures [11], [18]
Preventive Dentistry	Targeted oral hygiene protocols, fluoride therapy, caregiver counselling [2], [3], [9], [10]	Reduces caries incidence and improves overall oral health [17]
Digital Dentistry	Use of 3D printing and fully digital workflows [16], [17]	Delivers durable, patient-specific, and trauma-resistant restorations [2], [3]
Tele-Dentistry	Remote consultations, follow-up care, and interdisciplinary coordination [6], [16]	Expands access, ensures continuity, and improves patient monitoring [17]
Training & Education	Simulation-based seizure management modules for dentists [10], [11], [15]	Enhances professional preparedness and reduces emergency risks [11], [15]
Policy & Ethics	Development of standardized global protocols and AI regulations [7], [16]	Promotes safe, ethical, and equitable adoption of new technologies [7]

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