ISSN: 2582-6751
Journal of Clinical Medical Research

ATHENAEUM SCIENTIFIC PUBLISHERS

Review Article

Fear in the Dental Chair: A Narrative Review of Dental Anxiety Prevalence, Oral Health Consequences and the Evidence Behind Behavioral, Pharmacological and Sedation-Based Interventions

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Citation: Oropeza YC, et al. Fear in the Dental Chair: A Narrative Review of Dental Anxiety Prevalence, Oral Health Consequences and the Evidence Behind Behavioral, Pharmacological and Sedation-Based Interventions. Jour Clin Med Res. 2026;7(2):1-12.

https://doi.org/10.46889/JCMR.2026.7204

Received Date: 07-05-2026

Accepted Date: 25-05-2026

Published Date: 02-06-2026

Abstract

Background: Dental anxiety is a prevalent and clinically significant barrier to oral healthcare, affecting patients across all age groups and contributing to a well-documented cycle of avoidance, disease progression and increasingly complex treatment needs. Its etiology is multifactorial, encompassing psychological, neurobiological, environmental and socioeconomic determinants that extend well beyond pain perception alone.

Objective: To synthesize current evidence on the global prevalence of dental anxiety, its etiological determinants, its consequences for oral health and quality of life and the comparative effectiveness of behavioral, pharmacological and sedation-based management strategies, including considerations for special populations and emerging technologies.

Methods: A narrative review was conducted using PubMed, EMBASE and Web of Science. Articles published within the last five years were prioritized, with inclusion of seminal earlier works where appropriate. Systematic reviews, meta-analyses, randomized controlled trials and observational studies addressing both adult and pediatric populations were considered.

Results: Dental anxiety affects approximately 30% of young children and 15.3% of adults globally on validated instruments. Key etiological factors include prior traumatic dental experiences, adolescent exposure to violence, sensory hypersensitivity in older adults, lower socioeconomic status and HPA axis dysregulation with consequent amplification of pain perception. Untreated anxiety is consistently associated with higher rates of caries, periodontal disease and reduced oral health-related quality of life. Cognitive Behavioral Therapy holds the strongest long-term evidence base for dental phobia. Non-pharmacological techniques are effective first-line approaches, while nitrous oxide, oral sedation and general anesthesia provide appropriate escalation for moderate to severe cases. Virtual reality and internet-delivered CBT show early promise, particularly in pediatric populations.

Conclusion: Dental anxiety requires proactive identification and individualized management. A tiered multimodal approach, beginning with behavioral strategies and escalating pharmacologically when indicated, produces the best outcomes. Validated screening tools should be incorporated into routine new patient assessments and interprofessional collaboration between dental

and mental health providers remains essential to closing the gap between available evidence and consistent clinical practice.

Keywords: Dental Anxiety; Dental Fear; Odontophobia; Prevalence; Cognitive Behavioral Therapy; Nitrous Oxide; Oral Sedation; Virtual Reality; Oral Health-Related Quality of Life; Special Populations

Introduction: Fear in the Dental Chair: A Global Challenge at the Intersection of Psychology, Oral Health and Patient-Centered Care

Dental anxiety and fear represent one of the most prevalent yet underaddressed barriers to oral healthcare access worldwide. Epidemiological data consistently show that dental fear and anxiety affect a significant proportion of the global adult population, with a recent systematic review estimating a pooled prevalence of approximately 13.8% for any level of dental fear and up to 2.6% for severe dental anxiety or phobia in adults [1]. When more broadly defined, surveys suggest that more than 60% of individuals report some degree of nervousness associated with dental visits at some point in their lives [2]. These figures carry direct clinical weight: patients affected by dental fear are significantly more likely to postpone or avoid care altogether, creating a cycle of disease progression, more invasive treatment needs and further reinforcement of the original fear.

The experience is instantly recognizable to any clinician. From the moment a patient sits in the dental chair, the environment itself , the sounds, the smells, the instruments can activate a threat response that has little to do with the procedure at hand. It is not uncommon for a patient's first words to be some variation of "I really hate coming here," and in many cases that statement reflects years of avoidance, negative conditioning and unaddressed psychological distress rather than simple discomfort.

Defining the problem precisely matters for how we approach it. According to established psychiatric classification, a phobia is an intense, persistent and disproportionate fear of a specific stimulus or situation, causing significant functional impairment [3]. In the dental context, this manifests along a spectrum: from mild apprehension and anticipatory anxiety, to moderate fear that delays care, to diagnosable odontophobia at the severe end, where even thinking about a dental appointment can provoke a full anxiety response. These distinctions are clinically meaningful because they inform which management strategies are appropriate for each patient.

The triggers for dental fear are varied but well-documented. Research by Manoharan and Jayalakshmi identified the sound of the dental handpiece as the most anxiety-provoking stimulus among dental patients, followed by postoperative sensitivity or pain and the dental chair environment itself [4]. These responses may or may not be tied to a prior traumatic experience and importantly, they appear across patient populations regardless of sex or age, suggesting that vulnerability to dental fear is not confined to any particular demographic group [5].

The neurological underpinnings of this response have also been studied. Work by Racek and colleagues demonstrated that individuals with high pain expectation show activation in prefrontal cortical regions before a stimulus reaches the pain threshold [6]. This anticipatory cortical response does not equate to pain being felt in that moment, but it does appear to prime and amplify pain perception once the noxious stimulus arrives. In clinical terms, the fear of pain can be physiologically more impactful than the pain itself, which has profound implications for how we prepare and communicate with anxious patients.

In response to this challenge, a range of intervention strategies has been developed and studied. Behavioral techniques including hypnotherapy, systematic desensitization and cognitive restructuring have been applied with varying degrees of evidence [7]. Pharmacological approaches, from oral anxiolytics to inhalation sedation and intravenous agents, offer more direct physiological control of the fear response for moderate-to-severe cases. Even simple techniques such as structured diaphragmatic breathing have demonstrated measurable reductions in patient-reported anxiety during dental procedures [8]. In pediatric settings, distraction-based strategies such as clown therapy in waiting areas have shown promise in reducing pre-appointment stress and improving cooperation during treatment [9].

Identifying the anxious patient before the appointment begins is a prerequisite for any of these interventions to be effective. Validated screening tools, including the Modified Dental Anxiety Scale (MDAS) and the Dental Fear Survey (DFS), allow clinicians to stratify patients by anxiety level and tailor their approach accordingly. This patient-centered model represents the

evolution of dental anxiety management from the historically paternalistic or even coercive approaches of the past toward a framework grounded in communication, dignity and individualized care.

This narrative review examines the current evidence across the three main domains of dental anxiety management: behavioral and psychological interventions, pharmacological approaches and sedation-based techniques. The aim is to provide a clinically practical synthesis of what works, for whom and under what circumstances, while acknowledging the gaps that remain in the literature.

Epidemiology and Prevalence: How Common Is Fear in the Dental Chair?

Dental anxiety can be understood as an adaptive emotional response to a situation perceived as threatening or dangerous, mediated by activation of the sympathetic nervous system and manifesting as a physiological and psychological state that may present before, during or after a dental appointment [10]. This response is not pathological by definition, in measured doses, it represents a normal protective mechanism; but when it becomes disproportionate, persistent or functionally disabling, it crosses into territory that demands clinical attention and structured management.

Quantifying how many patients actually experience dental anxiety requires validated measurement instruments and the field has produced several. The Corah Dental Anxiety Scale (DAS), developed in 1969, consists of four structured questions addressing patients' feelings in anticipation of a dental visit, in the waiting room, before an injection and before tooth scaling. It remains one of the most widely used tools in epidemiological research. The Modified Dental Anxiety Scale (MDAS) builds on the DAS framework by adding a fifth item specifically addressing the experience of receiving local anesthesia, which significantly improves its sensitivity for a procedure that patients consistently rate as among the most anxiety-provoking [11,12]. A third instrument, the Dental Fear Survey (DFS), takes a broader approach by asking patients to rate their reactions to specific clinical procedures rather than situational scenarios, offering a more granular picture of procedure-specific fear. Each of these tools has distinct psychometric strengths and none can be considered universally superior. In fact, a recent bibliometric analysis of MDAS use across the literature from 2014 to 2023 revealed substantial inconsistency in how the scale is administered and interpreted across studies, with cut-off scores for dental phobia varying between ≥15 and ≥25 depending on the research group; a finding with direct implications for how prevalence estimates should be interpreted and compared across publications [13].

With that methodological context in mind, the epidemiological data tell a consistent story even if exact figures vary. A systematic review and meta-analysis drawing on PubMed, EMBASE and Web of Science identified 2,895 studies on dental fear and anxiety in early childhood, of which 25 met inclusion criteria for analysis. The pooled prevalence of dental fear and anxiety among children aged 2 to 6 years was estimated at 30% (95% CI: 25-36) [12]. Children without prior dental visit experience showed significantly higher odds of dental anxiety (OR = 1.37; 95% CI: 1.18-1.59), as did children with a history of caries (OR = 1.18; 95% CI: 1.09-1.27), compared to those with dental experience or caries-free status. This reinforces what clinicians observe daily: fear and disease feed each other. The child who never comes to the dentist develops decay and the decay makes the eventual appointment more traumatic, deepening the fear further [12].

Environmental factors play a documented role in shaping dental anxiety in children, including the physical characteristics of the clinical setting, the behavior and communication style of the dental team and the emotional influence of parents present during treatment [11]. These contextual variables are independent of the child's intrinsic temperament and suggest that the clinical environment itself is a modifiable risk factor, a point with direct practical consequences for how dental offices are designed and how practitioners are trained.

Prevalence estimates across the literature must be interpreted with caution, because the choice of measurement instrument substantially affects the numbers reported. Studies using broader single-question formats tend to capture higher prevalence rates, while those employing validated multi-item scales with clinical cut-offs yield more conservative figures. Cross-cultural comparisons are further complicated by translation issues, cultural attitudes toward expressing emotional distress and differences in the organization and accessibility of dental care systems. The MDAS, despite its widespread adoption and availability in multiple languages, is applied with enough variation in scoring and interpretation across research groups that direct comparison between studies is sometimes unreliable [13].

Certain patient populations carry a disproportionate burden of dental anxiety yet remain chronically underrepresented in the epidemiological literature. Patients with intellectual disabilities, serious mental health conditions or significant medical comorbidities frequently experience heightened anxiety responses in clinical settings, yet are often excluded from the observational studies that generate our prevalence estimates, the Sun, et al., systematic review, for instance, explicitly excluded children with special needs from its analysis [12]. Similarly, patients from low-income backgrounds face a compounded barrier: economic constraints already limit dental access and when those constraints interact with dental anxiety, the result is a pattern of avoidance that can persist for years and result in presentation with advanced, costly and painful disease. Addressing dental anxiety in these groups is not only a clinical priority but an equity issue.

Taken together, the evidence confirms that dental anxiety is a common, measurable and clinically significant condition across all age groups. The tools to identify it exist and are accessible. The gap lies not in detection capacity but in the consistent application of those tools at the point of care and in ensuring that the populations most affected by dental fear are not also the ones most invisible to the research that is supposed to inform their management.

Etiology and Risk Factors: What Drives Fear Into the Operatory

Despite remarkable advances in dental technology, anesthesia and pain management, a substantial proportion of patients continue to experience fear and anxiety when faced with a dental visit [14]. This disconnect between what modern dentistry can offer and what patients expect to feel is not irrational, it is deeply rooted in a network of psychological, biological, social and environmental factors that interact and reinforce one another over time. Understanding these factors is not an academic exercise; it is a clinical prerequisite, because an anxious patient whose underlying triggers are unidentified cannot be effectively managed [15].

It is important to distinguish between dental anxiety and dental fear, as these terms are related but not equivalent. Dental anxiety refers to a generalized apprehension about something unknown or uncertain, the patient who loses sleep the night before an appointment because they do not know exactly what will happen. Dental fear, by contrast, is a response to a recognized, specific threat: the needle, the sound of the drill, a particular procedure the patient has experienced before and anticipates again with dread [15]. Both exist on a continuum that ends in diagnosable odontophobia and both require attention, though the management approach may differ depending on where on that spectrum the patient sits.

Traumatic past dental experiences represent the single most consistently identified risk factor in the literature [16]. These experiences function through classical conditioning: a painful or frightening encounter in the dental chair creates an associative memory in which the stimuli of that environment, the smell of eugenol, the sound of the suction, the sight of the instrument tray, become conditioned cues capable of triggering a full anxiety response independently of any actual threat. Research examining the qualitative content of patients' dental memories confirms that characteristics of emotional fear memories, including sensory vividness, intrusive recall and affective intensity; are disproportionately present in individuals who endorse high dental fear or report a history of traumatic dental visits [17,18]. This helps explain why patients who had a single frightening childhood experience can remain avoidant for decades: the memory is not simply recollected but re-experienced at a physiological level each time the relevant cues appear.

The picture is complicated further by parental transmission. Children are not blank slates in the dental chair; they arrive having already absorbed their caregivers' attitudes toward dental treatment. Parents with high dental fear communicate that fear both verbally and through behavioral cues and children are highly attuned to these signals. This intergenerational transmission is well-documented and helps explain why dental anxiety clusters within families independently of shared traumatic experiences [14].

Different age groups present distinct etiological profiles. In preschool-aged children, a study of 160 patients aged one to six years found that needle fear received the highest scores on the Children's Fear Survey Schedule; Dental Subscale (CFSS-DS) and that the strongest predictors of dental anxiety were prior negative dental experiences, lower socioeconomic status and anticipated need for complex treatment such as extraction [19]. Among adolescents, the etiological landscape broadens significantly. Exposure to violence, including bullying, physical abuse and intimate partner violence in the home, has been independently associated with dental fear in this age group, suggesting that generalized threat experiences outside the dental setting can

sensitize young people to clinical fear responses [16]. In older adults, sensory characteristics of the dental environment take on greater significance. A cross-age study using an integrated Kano-IPA model identified instrument noise, experienced pain and distressing visual stimuli from clinical equipment as the primary drivers of dental fear in elderly patients; factors that are heavily modifiable through environmental design and clinician behavior [20,21].

At the neurobiological level, dental anxiety activates the Hypothalamic-Pituitary-Adrenal (HPA) axis, triggering the release of cortisol as part of the body's acute stress response. Elevated cortisol lowers the pain threshold, increases physiological arousal and sustains the anxiety state beyond the immediate trigger, meaning that the anxiety response can persist throughout and even after a dental appointment. Research on salivary biomarkers in anxiety disorders confirms the role of cortisol and sympathetic-adrenal-medullary system activation in amplifying perceived distress, with direct relevance to the dental clinical context [21]. This biological amplification loop, where anxiety raises cortisol, which in turn lowers pain tolerance and increases anxiety further, is one of the reasons anxious patients consistently report more pain than non-anxious patients for objectively equivalent procedures.

The clinical consequences of unmanaged dental anxiety are serious and cumulative. Patients who avoid regular visits develop conditions, gingivitis, periodontitis, periapical abscesses; that progress silently until they become painful, complex and expensive to treat [15]. By the time the anxious patient finally presents, often driven by pain they can no longer endure, the clinical encounter is inevitably more invasive than it would have been with earlier intervention. That invasiveness reinforces the original fear and the cycle deepens.

Breaking this cycle begins with identifying the anxious patient before treatment starts, understanding the specific nature of their fear and building a therapeutic relationship rooted in trust, transparency and respect for their autonomy. These are not soft skills, they are the clinical foundation on which every other management strategy depends [18].

Oral Health Consequences: The Clinical Cost of Avoidance

The clinical consequences of dental anxiety extend far beyond the emotional discomfort experienced in the waiting room. When fear reliably prevents patients from attending regular dental appointments, it becomes a direct driver of oral disease, not a psychological curiosity, but a measurable public health problem. Many of the most prevalent oral conditions, including dental caries, gingivitis and early-stage periodontitis, are initially asymptomatic and highly amenable to management when detected at routine visits. Left unmonitored in the absence of preventive care, they progress silently into complex, destructive pathologies requiring substantially more invasive and costly treatment. Evidence from longitudinal research confirms that individuals with elevated dental anxiety are significantly more likely to postpone or entirely avoid dental care over time, resulting in a progressive deterioration of oral health status [22].

The relationship between dental anxiety and oral health deterioration is not linear, it is cyclical and self-reinforcing. Anxiety produces avoidance; avoidance allows disease to advance; the more advanced the disease, the more invasive the treatment required at the eventual appointment; and the more invasive the treatment, the deeper the anxiety becomes for the next encounter. This cycle is well-recognized in the literature and poses significant clinical management challenges, contributing to appointment cancellations, reduced adherence to multi-visit treatment plans, prolonged treatment courses and a clinical environment made more difficult by the patient's escalating distress [22].

The behavioral consequences of dental anxiety compound this picture. Anxious patients are more likely to attend irregularly, withdraw from scheduled care and manage acute dental pain with over-the-counter analgesics rather than seeking timely professional intervention; a pattern that may temporarily suppress symptoms while the underlying condition worsens [23]. These behaviors accelerate oral health deterioration and reinforce the very avoidance cycle that drives them.

Clinically, the measurable outcomes of this avoidance are well-documented. Studies have shown that patients with higher dental anxiety scores tend to present with more decayed and missing teeth, consistent with delayed treatment-seeking behavior across the course of their dental history [24]. The association extends beyond hard tissue disease: dental anxiety has been shown to act as a specific barrier to periodontal care, with patients diagnosed with periodontitis exhibiting significantly higher dental anxiety scores than periodontally healthy controls and those reporting moderate to extreme anxiety demonstrating meaningfully worse

Oral Health-Related Quality of Life (OHRQoL) compared to non-anxious patients [25]. These findings reinforce the conclusion that dental anxiety does not simply delay care, it selectively disadvantages patients with conditions that are particularly dependent on regular professional monitoring and maintenance.

More broadly, higher dental anxiety levels are consistently associated with poorer OHRQoL, with patients reporting increased pain, difficulty eating and chewing, reduced social confidence related to dental appearance and significant psychosocial burden [23]. These quality-of-life impacts extend the consequences of dental anxiety well beyond the oral cavity and into the domains of daily functioning and psychological well-being.

An important but often overlooked modifying factor is Oral Health Literacy (OHL). Patients with lower OHL scores consistently report higher levels of dental anxiety, likely because limited understanding of dental conditions and procedures increases uncertainty and heightens the perceived threat of the clinical encounter. Conversely, when patients have a clearer conceptual framework for what dental treatment involves and why it matters, anxiety tends to be lower and treatment acceptance higher.[26] Research suggests a combined effect of dental anxiety and oral health literacy on OHRQoL, meaning that interventions addressing both simultaneously may have a synergistic benefit that exceeds what either approach achieves alone [26]. This has direct implications for how dental teams communicate with anxious patients: patient education is not merely a courtesy, it is a component of anxiety management with measurable clinical value.

Taken together, these findings make a compelling case for integrating anxiety identification and management into standard clinical workflows. Early detection using validated screening tools, paired with targeted communication strategies and patient-centered education, can reduce the downstream consequences of dental anxiety and interrupt the self-perpetuating cycle before it reaches its most destructive stage [27].

Multimodal Management: Behavioral, Pharmacological and Sedation-Based Interventions

Effective management of dental anxiety cannot be reduced to a single approach. Because fear operates across psychological, physiological and behavioral dimensions simultaneously, the clinical evidence consistently points toward a multimodal strategy, one that combines psychological and behavioral techniques with pharmacological support when indicated, calibrated to the patient's age, severity of anxiety and specific clinical needs [28]. No single intervention works for every patient and understanding the evidence base for each modality is essential to making sound clinical decisions [29].

Among behavioral and psychological interventions, Cognitive Behavioral Therapy (CBT) holds the strongest evidence base [30,31]. CBT works by helping patients identify and restructure maladaptive thoughts about dental treatment, combining cognitive reframing with graduated exposure to feared stimuli to break the avoidance cycle. A systematic review and meta-analysis of randomized controlled trials found that CBT produced moderate-certainty evidence of a meaningful reduction in chronic dental trait anxiety and was also the most effective psychotherapy for patients meeting diagnostic criteria for dental phobia, outperforming other psychological approaches on long-term outcomes [32].

Beyond CBT, a range of non-pharmacological behavioral techniques have proven useful, particularly in pediatric populations. Modeling; where a child observes another child or video demonstrating calm, cooperative behavior during a dental procedure; uses social learning to normalize the experience and reduce anticipatory fear [28]. The Tell-Show-Do technique is one of the most widely used foundational approaches in pediatric dentistry: the clinician first explains the procedure in age-appropriate language, then demonstrates on a non-threatening instrument or area and finally proceeds with the actual procedure, building predictability and trust at each stage [29.] A comprehensive review of non-pharmacological approaches across surgical and dental settings found these techniques effective across different ages and clinical contexts, reinforcing their value as first-line management before any pharmacological escalation is considered [30].

When non-pharmacological approaches are insufficient, pharmacological sedation offers a well-established alternative or adjunct. For mild dental anxiety in children, nitrous oxide-oxygen (N_2O/O_2) inhalation sedation remains the gold standard: it has a rapid onset of approximately 30 to 60 seconds, demonstrated efficacy rates of 85-92%, fewer than 5% adverse events and full recovery within five minutes of discontinuation, making it well-suited to outpatient pediatric settings [33]. For moderate anxiety or procedures where N_2O alone is insufficient, oral sedation agents such as midazolam offer stronger anxiolytic and

amnestic effects, with success rates in the range of 70-85%, though with a higher incidence of paradoxical excitation in some pediatric patients. Combination protocols; such as midazolam plus dexmedetomidine, have shown improved cooperation and sedation depth without proportional increases in adverse events compared to single-agent protocols [31]. The most serious risk associated with oral sedation regimens remains respiratory depression, particularly when multiple central nervous system depressants are combined, underscoring the need for careful pre-sedation planning, standardized monitoring and trained personnel [34].

For adults, benzodiazepines are commonly used for procedural anxiolysis, particularly during oral surgery, where they reliably reduce state anxiety during the procedure. However, their effects are acute and do not address the underlying fear; long-term management of dental anxiety in adults requires psychological intervention alongside or following pharmacological support [32].

Parental perspectives on management techniques offer a practical lens for clinical decision-making. Research examining parental acceptance of behavior management approaches found that audiovisual aids were the most accepted technique, followed by Tell-Show-Do and general anesthesia, while oral sedation was the least preferred option among parents surveyed [35]. These preferences are clinically important because parental buy-in significantly affects compliance in pediatric treatment planning.

General Anesthesia (GA) occupies a distinct position in the management hierarchy. It is reserved for patients, typically children or adults with significant medical, cognitive or psychiatric comorbidities, who cannot tolerate conventional dental treatment in an outpatient setting. The administration of GA requires a trained anesthesiologist, appropriate hospital or surgical facility infrastructure and meticulous interdisciplinary collaboration between the dental and anesthesia teams, particularly because the airway is shared during dental procedures under GA. Rigorous informed consent, pre-anesthetic assessment and adherence to safety protocols are non-negotiable requirements. When managed appropriately, GA allows comprehensive dental rehabilitation in a controlled setting for patients who have no other viable alternative [35].

The choice of intervention; behavioral, pharmacological or anesthetic, should never be made by default. It should follow a structured assessment of the patient's anxiety level using a validated tool, consideration of the clinical complexity of the required treatment and a frank discussion with the patient and, where relevant, their family. The most effective management is the one tailored to the individual in front of you.

Conclusion Fear to Trust: Building an Evidence-Based Framework for Anxiety-Conscious Dental Practice

The evidence reviewed across this paper converges on a conclusion that is both clinically straightforward and persistently under implemented: dental anxiety is a legitimate, measurable and manageable clinical condition that demands proactive recognition rather than reactive accommodation. Its causes are multifactorial, rooted in prior traumatic experiences, psychological vulnerability, environmental triggers and neurobiological amplification and it operates across the lifespan, presenting differently in children, adolescents, adults and older patients while remaining consistently associated with treatment avoidance, oral health deterioration and reduced quality of life [36,37].

The self-perpetuating cycle that links anxiety to avoidance, avoidance to disease progression and disease progression to more invasive and fear-reinforcing treatment is one of the most well-documented dynamics in dental public health [38]. Despite this, it continues to be encountered daily in clinical practice, not because dentists lack awareness, but because the systems and tools to interrupt it are inconsistently applied. Surveys of general practitioners reveal that many clinicians rely on informal observation and clinical intuition to identify anxious patients rather than validated screening instruments and that formal training in anxiety management varies considerably across dental programs [36]. This gap between the available evidence and its translation into routine practice is arguably the central problem the field needs to address.

The management landscape is meaningfully better than it was a generation ago. Non-pharmacological approaches, particularly CBT, graduated exposure and behavioral guidance techniques such as Tell-Show-Do, carry solid evidence bases and produce durable reductions in anxiety when applied correctly [39,40]. Pharmacological options, from nitrous oxide inhalation to oral sedation with benzodiazepines and, in complex cases, general anesthesia, provide clinically effective tools for patients whose anxiety cannot be adequately managed through behavioral means alone [41]. The evidence consistently supports a tiered,

multimodal approach in which behavioral strategies are always attempted first, pharmacological support is added where necessary and no single intervention is treated as universally applicable.

Several important gaps remain in the literature and deserve explicit acknowledgment. First, the majority of studies comparing behavioral and pharmacological interventions are limited by small sample sizes, short follow-up periods and heterogeneous outcome measures that make cross-study comparison difficult [39]. High-quality, adequately powered head-to-head randomized controlled trials comparing different management strategies, particularly those that include long-term follow-up beyond the treatment episode; are still scarce. Second, oral health literacy has emerged as a modifiable factor that independently influences both anxiety levels and quality-of-life outcomes, yet it is rarely incorporated into anxiety management protocols in clinical practice.[37] Third, certain populations remain chronically understudied: patients with intellectual disabilities, medically complex presentations and those from low-income or rural backgrounds face compounded barriers to care that standard management frameworks do not adequately address.

Practical implications follow clearly from this evidence. Validated anxiety screening tools; the MDAS, DAS or DFS, should be integrated into all new patient assessments as a matter of routine rather than reserved for patients who self-declare their fear. Many anxious patients do not volunteer information about their anxiety; they minimize it, rationalize it or simply do not attend [36]. Clear communication about what to expect during treatment, permission to signal discomfort and guaranteed control breaks cost nothing and consistently improve patient experience and cooperation across anxiety levels [38]. These are not supplementary courtesies, they are evidence-based clinical behaviors.

There is also a compelling case for interprofessional collaboration. For patients with severe dental anxiety or diagnosable odontophobia, the most effective outcomes are achieved through coordinated care between dental practitioners and mental health providers trained in exposure-based therapies [39]. This model is not widely implemented in most healthcare systems and dental education programs rarely provide the training needed for dentists to recognize when referral to a psychologist or behavioral specialist is clinically indicated. Strengthening this component of dental training; including formal instruction in anxiety recognition, motivational interviewing and the criteria for psychological referral, should be a priority for dental schools and postgraduate programs.

Dental anxiety is not a trivial inconvenience; rather, it is a clinically significant condition with tangible repercussions for oral health, overall quality of life and the patient's ongoing engagement with the healthcare system. Its effects extend beyond isolated dental visits, influencing treatment outcomes, patient cooperation and the likelihood of future attendance. Approaching dental care solely from a procedural standpoint, dressing the tooth without considering the underlying fear, often means tackling only part of the problem. Effective treatment requires recognition that anxiety is an integral component of the patient's experience and must be managed alongside clinical needs [40].

When clinicians make a deliberate effort to understand and address dental anxiety, the benefits are not limited to improving the immediate appointment. Instead, such an investment lays the groundwork for future care, fostering trust and enabling patients to return for subsequent visits, ultimately supporting better long-term oral health outcomes.

Special Populations and Emerging Technologies: Closing the Gaps in Dental Anxiety Management

The management strategies reviewed in the preceding sections were developed and tested predominantly in cooperative adult patients or children without significant comorbidities. This is not a trivial limitation. Dental anxiety does not distribute itself evenly across the population; it concentrates in groups who already face structural disadvantages in accessing care and whose clinical management requires adaptations that go well beyond what standard protocols provide. Equally, the technological landscape of anxiety management is evolving rapidly, offering new tools that have real potential but also real limitations that the evidence has not yet fully resolved. Both of these areas, vulnerable populations and emerging technologies; represent the frontier of this field and both deserve explicit attention in any contemporary review [41].

Patients with Intellectual and Developmental Disabilities

Among the most underserved populations in dental care are individuals with Intellectual and Developmental Disabilities (IDD). This group faces a compounding of challenges that makes dental anxiety both more prevalent and more difficult to manage.

Cognitive impairment limits the individual's ability to understand explanations of procedures, to exercise voluntary control over anxiety responses or to communicate distress in ways that clinicians easily recognize. Sensory hypersensitivity, common in IDD and particularly in autism spectrum disorder, means that the standard dental environment itself, with its bright lights, high-pitched instrument sounds, unfamiliar smells and unexpected tactile sensations, may be inherently overwhelming independent of any specific procedure [41].

Sensory Adaptive Dental Environments (SADE) have emerged as one of the most evidence-supported environmental modifications for this population. A systematic review and meta-analysis by Reynolds and colleagues found that structured environmental modifications, including dimmed lighting, noise reduction, weighted blankets and visual schedules; produced measurable reductions in physiological markers of anxiety and improved cooperative behavior in children and young adults with IDD during dental treatment [42]. The effect sizes were clinically meaningful and the approach is non-pharmacological, reversible and relatively low-cost to implement. Despite this, SADE remains inconsistently available in general dental practice and most practitioners receive no formal training in its application.

General anesthesia is frequently used as a default for patients with IDD who cannot tolerate routine dental care, but this carries its own risk profile and does not address the underlying anxiety for future appointments. Conscious sedation with nitrous oxide has been identified as a preferable first-line pharmacological option for this group when behavioral approaches alone are insufficient, offering a better safety margin than deeper sedation protocols in this population [41].

Elderly Patients

Older adults represent another population whose relationship with dental anxiety has particular characteristics. Evidence suggests that anxiety prevalence tends to decrease with age in community-dwelling adults, possibly reflecting adaptation, lower expectations of treatment or reduced emotional reactivity to threat [23]. However, this does not mean that anxiety is clinically insignificant in this group. Elderly patients; particularly those in rural or low-resource settings, demonstrate very high rates of dental anxiety when measured systematically, with one study reporting that over 90% of rural community-dwelling older adults met criteria for dental anxiety on validated scales and nearly 67% were classified as extremely anxious or phobic [23]. The sensory triggers documented in this population are distinct: noise from dental instruments, pain experience and distressing visual stimuli from clinical equipment carry disproportionate weight, suggesting that environmental modification and careful procedural communication are at least as important for elderly patients as pharmacological approaches [20].

Patients from Low-Income and Underserved Backgrounds

Dental anxiety and socioeconomic disadvantage interact in ways that are clinically and epidemiologically significant but poorly studied. Patients from low-income backgrounds already face structural access barriers, cost, insurance gaps, geographic distance; and dental anxiety compounds these barriers by reducing the likelihood of attendance even when access is technically available. As of 2024, approximately 57 million Americans lived in a dental health professional shortage area and large proportions of low-income adults lacked any dental insurance coverage, creating conditions in which disease progresses unchecked until emergency presentation is the only option [43]. When these patients finally present, their anxiety is typically severe, their disease is advanced and the treatment encounter is maximally invasive, reinforcing all the original fears. Addressing this cycle requires more than clinical technique; it requires health system redesign, public oral health literacy initiatives and policy commitments to expanding dental coverage for underserved populations.

Virtual Reality as an Emerging Anxiety Management Tool

Virtual Reality (VR) has attracted substantial research interest as a distraction and desensitization tool for dental anxiety. The fundamental mechanism is immersive distraction: by engaging the patient's visual and auditory attention in a compelling virtual environment, VR competes with the cognitive processing of anxiety-provoking stimuli from the clinical setting. Evidence from a systematic review and meta-analysis demonstrated that VR produced significant anxiety reductions in children during dental procedures, with moderate certainty of evidence and also reduced pain perception in both children and adults [44]. However, its efficacy in adults for anxiety specifically, as opposed to pain, remains less established, with current evidence rated as low certainty. Practical limitations also remain equipment cost, hygiene protocols for shared headsets and the need for adequate content libraries calibrated to different patient ages and procedure types all constrain widespread adoption. VR is best understood at this stage as a promising adjunct rather than a standalone intervention, most clearly supported for pediatric use

in procedures involving moderate anxiety.

Internet-Delivered Cognitive Behavioral Therapy

One of the most significant access barriers to CBT for dental anxiety is simple availability, there are far too few psychologists trained in this modality working in or adjacent to dental settings. Internet-delivered CBT (iCBT) addresses this directly by delivering structured exposure-based treatment remotely, guided by a therapist, over a series of weeks. A randomized controlled trial enrolling children and adolescents with diagnosed dental phobia or injection phobia found that therapist-guided iCBT based on exposure therapy over 12 weeks led to meaningful reductions in phobia severity and improved ability to receive dental treatment, compared with a waitlist control group [45]. These gains were maintained at one-year follow-up, which is clinically significant given the durability problems that have plagued purely pharmacological approaches. iCBT offers scalability, geographic reach and cost-effectiveness advantages over in-person therapy and its application to dental phobia in both pediatric and adult populations represents one of the most promising directions in the field.

Future Research Priorities

Several research gaps emerge clearly from this review. There is a persistent shortage of high-quality RCTs comparing behavioral and pharmacological management strategies head-to-head, with adequate follow-up periods and standardized outcome measures that would allow meaningful cross-study synthesis. The evidence base for managing dental anxiety in patients with IDD, psychiatric comorbidities and medically complex presentations remains thin and methodologically inconsistent. The long-term outcomes of VR-based interventions beyond the immediate procedure have not been adequately studied. And perhaps most practically, there is still no consensus on a standardized anxiety screening protocol for routine dental practice, a gap that limits the translation of research findings into clinical reality.

Closing these gaps requires coordinated effort across research, clinical training and health policy. Dental education programs must formalize instruction in anxiety recognition, validated screening and management; including the criteria for referral to behavioral health specialists. Research funders should prioritize studies that include vulnerable populations rather than excluding them for methodological convenience. And health systems must recognize dental anxiety not as a patient personality trait but as a clinical condition with measurable consequences, one that is both treatable and, with appropriate early intervention, preventable.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding Statement

This research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.

Acknowledgement

The authors have no acknowledgments to declare.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Not applicable.

Authors' Contributions

All authors contributed equally to this paper.

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