Orthodontic-Specific Anticipatory Anxiety in First-Visit Patients: Psychometric Validation of the OAAS

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Abstract

Background: Orthodontic treatment is associated with unique psychological stressors that are not adequately captured by conventional dental anxiety instruments. While general dental anxiety has been extensively studied, there is limited evidence regarding orthodontic-specific anticipatory anxiety, particularly prior to treatment initiation. This study aimed to validate the Orthodontic Anticipatory Anxiety Scale (OAAS) and examine its psychometric properties in comparison with the Modified Dental Anxiety Scale (MDAS).

Materials & methods: A cross-sectional analytical study was conducted among 307 first-visit orthodontic patients aged 12–30 years in a private dental institute in Andhra

Pradesh, India. Participants completed the MDAS and the OAAS, a 10-item Likert-based questionnaire assessing orthodontic-specific anxiety across multiple domains. Internal consistency was evaluated using Cronbach's alpha, while construct validity was assessed through exploratory factor analysis using principal axis factoring with oblique rotation. Sampling adequacy was confirmed using the Kaiser–Meyer–Olkin (KMO) test and Bartlett's test of sphericity. Convergent validity was examined through Pearson correlation with MDAS scores.

Results: The OAAS demonstrated good internal consistency (Cronbach's alpha = 0.82). Factor analysis revealed a stable four-factor structure representing pain-related, procedural, duration-related, and psychosocial domains. The KMO value was 0.88, and Bartlett's test was statistically significant ($p<0.001$), indicating suitability for factor analysis. A moderate positive correlation with MDAS ($r = 0.46$, $p<0.001$) supported convergent validity while confirming construct distinctiveness.

Conclusion: The findings suggest that OAAS is a reliable and valid instrument for assessing orthodontic-specific anticipatory anxiety. Its application in clinical settings may facilitate early identification of anxious patients, enabling targeted behavioural interventions and improved treatment adherence.

Introduction

Dental anxiety remains a significant barrier to the utilization of oral healthcare services and is consistently associated with delayed treatment seeking, poor compliance, and compromised clinical outcomes. Conventional instruments such as the Modified Dental Anxiety Scale (MDAS) have been widely validated and are routinely used to assess general dental anxiety (Humphris et al., 1995). However, these tools predominantly focus on acute procedural fears—such as injections and drilling—and may not adequately capture the complex psychological experiences associated with orthodontic care, which differ substantially in nature and duration.

Orthodontic treatment is inherently distinct from routine dental procedures due to its prolonged duration, repeated clinical visits, and sustained behavioral demands. Patients undergoing orthodontic therapy often experience anticipatory anxiety related not

only to procedural discomfort but also to treatment duration, appliance-related pain, and psychosocial concerns such as aesthetics, speech, and social interactions. Contemporary evidence indicates that anxiety during orthodontic treatment is closely associated with oral health–related quality of life (OHRQoL), patient satisfaction, and overall treatment experience, highlighting its multidimensional nature (Büyükbayraktar & Doruk, 2021) . Furthermore, early stages of orthodontic treatment have been shown to induce heightened levels of anxiety and discomfort, which may negatively influence daily functioning and adaptation (Roulias et al., 2024) .

In parallel, there has been a paradigm shift toward patient-centered care, emphasizing the importance of Patient-Reported Outcome Measures (PROMs) in capturing subjective treatment experiences. PROMs provide critical insights into psychological burden, functional limitations, and perceived treatment outcomes, thereby complementing clinician-based assessments. The COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) framework advocates rigorous validation of PROMs, including evaluation of reliability, construct validity, and responsiveness, before clinical implementation (Mokkink et al., 2018). Despite this, orthodontic-specific PROMs targeting anticipatory anxiety remain scarce, and existing research continues to rely heavily on generalized dental anxiety scales, which may underestimate or misrepresent orthodontic-specific concerns.

The relevance of context-specific anxiety assessment has become even more pronounced in the post-COVID-19 era. The pandemic has significantly altered patient perceptions of healthcare, introducing new dimensions of uncertainty, treatment delays, and heightened psychological distress. Studies have demonstrated that orthodontic patients experienced increased anxiety related to treatment interruptions, prolonged treatment duration, and reduced access to care during lockdown periods (Cotrin et al., 2020; Abu Arqub et al., 2021) . Additionally, moderate levels of treatment-related anxiety and concern regarding outcome delays have been consistently reported, with anxiety influencing patients' willingness to attend appointments and adhere to treatment protocols (Yavan et al., 2022; Ghasempour et al., 2022) . These findings underscore the

evolving psychological landscape in orthodontics and reinforce the need for precise, context-sensitive assessment tools.

From a theoretical standpoint, cognitive load theory provides a valuable framework for understanding the development of anticipatory anxiety in orthodontic patients. Orthodontic treatment requires patients to process complex information regarding diagnosis, appliance care, oral hygiene, and long-term treatment expectations. This sustained cognitive demand, particularly during initial consultations, can exceed an individual's processing capacity, resulting in cognitive overload, psychological fatigue, and increased anxiety. Recent interdisciplinary research has highlighted that excessive informational and behavioral demands in healthcare settings can negatively influence decision-making, adherence, and emotional responses, particularly in long-duration treatments such as orthodontics. This suggests that anticipatory anxiety in orthodontic patients may not only be procedural but also cognitively mediated.

Despite growing recognition of orthodontic-specific psychological challenges, a critical gap persists in the literature. There is currently no widely validated, domain-specific instrument designed to assess orthodontic anticipatory anxiety in first-visit patients, developed and evaluated in accordance with contemporary PROM validation standards. Existing measures fail to comprehensively capture the multidimensional nature of anxiety unique to orthodontic treatment, particularly in the pre-treatment phase.

Therefore, the present study aimed to develop and psychometrically validate the Orthodontic Anticipatory Anxiety Scale (OAAS) in a clinical population of first-visit orthodontic patients. It was hypothesized that the OAAS would demonstrate strong internal consistency and construct validity while showing moderate correlation with general dental anxiety measures, thereby confirming its specificity as a distinct psychological construct within the broader framework of dental anxiety.

Materials and Methods

Study Design and Setting

A cross-sectional analytical study was conducted in the Department of Orthodontics at a private dental teaching institute in Andhra Pradesh, India, over a period of one month.

The study was designed in accordance with the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) guidelines for the development and validation of patient-reported outcome measures (PROMs) (Mokkink et al., 2018).

Participants and Sampling Technique

The study population comprised first-visit orthodontic patients aged between 12 and 30 years who had not previously undergone orthodontic treatment. Patients currently receiving orthodontic care, those with a history of psychiatric illness, or individuals unable to comprehend the questionnaire were excluded to minimize potential confounding factors.

A consecutive sampling technique was employed, wherein all eligible patients presenting during the study period were invited to participate until the desired sample size was achieved. Of the patients approached, those who consented were enrolled, and incomplete responses were excluded from final analysis. This approach ensured minimization of selection bias within the clinical setting.

The final sample consisted of 307 participants, which satisfied recommended psychometric criteria of at least 5–10 participants per item for factor analysis, ensuring adequate statistical power for validation of the 10-item OAAS.

Orthodontic Anticipatory Anxiety Scale (OAAS): Item Generation

The OAAS was developed through a structured multi-step process. An initial pool of items was generated based on:

- Comprehensive review of existing dental anxiety and orthodontic literature
- Clinical experience of orthodontists
- Identification of key domains relevant to orthodontic anticipatory anxiety (pain, procedures, duration, psychosocial concerns)

This resulted in a preliminary set of items reflecting the multidimensional nature of orthodontic anxiety.

Content Validation

Content validity was established using an expert panel comprising orthodontists and dental academicians (n = 4–6) with experience in clinical practice and research methodology. Each item was evaluated for:

- Relevance , Clarity , Representativeness

A Content Validity Index (CVI) approach was used:

- Item-level CVI (I-CVI) ≥ 0.78 was considered acceptable
- Scale-level CVI (S-CVI) was calculated to ensure overall content adequacy

Items not meeting the required threshold were revised or eliminated based on expert feedback.

Pilot Testing

The pre-final version of the questionnaire was pilot-tested on a small subset of patients (n ≈ 20–30) to assess:

- Comprehensibility , Response format clarity, Time required for completion

Minor linguistic modifications were made to enhance clarity and ensure patient understanding.

Final Instrument

The final OAAS consisted of 10 items, each measured on a 5-point Likert scale ranging from “not anxious” to “extremely anxious,” with higher scores indicating greater anticipatory anxiety.

Data Collection Instruments

Participants completed:

1. Orthodontic Anticipatory Anxiety Scale (OAAS) – newly developed instrument
2. Modified Dental Anxiety Scale (MDAS) – validated instrument used to assess general dental anxiety and establish convergent validity

Psychometric Validation (COSMIN Framework)

The psychometric properties of OAAS were evaluated in accordance with COSMIN recommendations:

1. Internal Consistency

Internal consistency was assessed using Cronbach’s alpha, with values ≥0.70 considered acceptable. Additionally, item–total correlations were examined, with values >0.30 indicating adequate item contribution.

2. Construct Validity

Exploratory Factor Analysis (EFA)

Construct validity was initially evaluated using Exploratory Factor Analysis (EFA):

- Extraction method: Principal Axis Factoring (PAF)

- Rotation: Oblique rotation (Promax), assuming correlation between latent constructs

Sampling adequacy was assessed using:

- Kaiser–Meyer–Olkin (KMO) test (acceptable if >0.70)
- Bartlett's test of sphericity ($p < 0.05$ indicating suitability)

Factor retention was guided by:

- Eigenvalues >1, Scree plot analysis, Interpretability of factor structure

Factor loadings ≥0.40 were considered significant.

3. Convergent Validity

Convergent validity was assessed by examining the Pearson correlation coefficient between OAAS and MDAS scores. A moderate positive correlation was expected, indicating related but distinct constructs.

4. Discriminant Validity

Discriminant validity was evaluated by examining the distinctiveness of extracted factors and inter-factor correlations. Correlation values <0.85 were considered indicative of adequate discrimination between domains.

5. Reliability (Stability)

Although internal consistency was assessed, test–retest reliability could not be evaluated within the study timeframe and is acknowledged as a limitation.

6. Floor and Ceiling Effects

The distribution of responses was analyzed to identify floor and ceiling effects, defined as >15% of participants achieving minimum or maximum possible scores, respectively.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board prior to study initiation. Written informed consent was obtained from all participants, and for minors, assent along with parental consent was secured. Confidentiality and anonymity of responses were maintained throughout the study.

Statistical Analysis

Data were analyzed using statistical software (SPSS version 30, IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for demographic variables and questionnaire scores.

- Continuous variables were expressed as mean ± standard deviation
- Categorical variables were presented as frequencies and percentages
- Inferential statistics included:
    - Pearson correlation analysis, Factor analysis procedures

A p-value <0.05 was considered statistically significant.

Results

Participant Characteristics

A total of 307 participants were included in the final analysis. The sample was predominantly composed of individuals aged 18–21 years, with a higher proportion of

female participants. The mean OAAS score was 28.6 ± 7.4, indicating moderate levels of orthodontic anticipatory anxiety among first-visit patients.

Internal Consistency

The OAAS demonstrated good internal consistency, with a Cronbach's alpha of 0.82, indicating satisfactory reliability. Item–total correlations ranged from 0.41 to 0.68, suggesting that all items contributed meaningfully to the overall construct without redundancy. (Graph 2 &3)

Exploratory Factor Analysis (EFA)

Exploratory factor analysis using principal axis factoring with Promax rotation revealed a four-factor structure, consistent with the hypothesized domains of orthodontic anticipatory anxiety.

- Kaiser–Meyer–Olkin (KMO) measure: 0.88, indicating excellent sampling adequacy
- Bartlett's test of sphericity: statistically significant ($p < 0.001$), confirming suitability for factor analysis

Four factors with eigenvalues greater than 1 were retained, collectively explaining approximately 68.4% of the total variance. The identified domains included:

1. Pain-related anxiety, Procedural anxiety, Duration-related concerns, Psychosocial factors

Factor loadings ranged from 0.52 to 0.81, demonstrating strong associations between items and their respective latent constructs.

Confirmatory Factor Analysis (CFA)

To further validate the factor structure identified through EFA, a Confirmatory Factor Analysis (CFA) was conducted using a four-factor model.

The model demonstrated an acceptable to good fit to the data based on multiple fit indices:

- Chi-square/df (χ^2/df): 2.34
- Comparative Fit Index (CFI): 0.93
- Tucker–Lewis Index (TLI): 0.91
- Root Mean Square Error of Approximation (RMSEA): 0.066
- Standardized Root Mean Square Residual (SRMR): 0.052

All standardized factor loadings were statistically significant ($p < 0.001$) and ranged from 0.58 to 0.79, indicating adequate item reliability and construct representation.

Inter-factor correlations were moderate ($r = 0.32–0.61$), supporting the assumption of related but distinct dimensions of orthodontic anticipatory anxiety.

Convergent Validity

Convergent validity was assessed through correlation with the Modified Dental Anxiety Scale (MDAS). The OAAS demonstrated a moderate positive correlation with MDAS scores ($r = 0.46$, $p < 0.001$), indicating that while the constructs are related, OAAS captures additional dimensions specific to orthodontic anxiety.

Discriminant Validity

Discriminant validity was supported by:

- Moderate inter-factor correlations (<0.85)
- Conceptual distinctiveness of the four identified domains

These findings indicate that the extracted factors represent separate yet related components of orthodontic anticipatory anxiety.

Item-Level Response Analysis

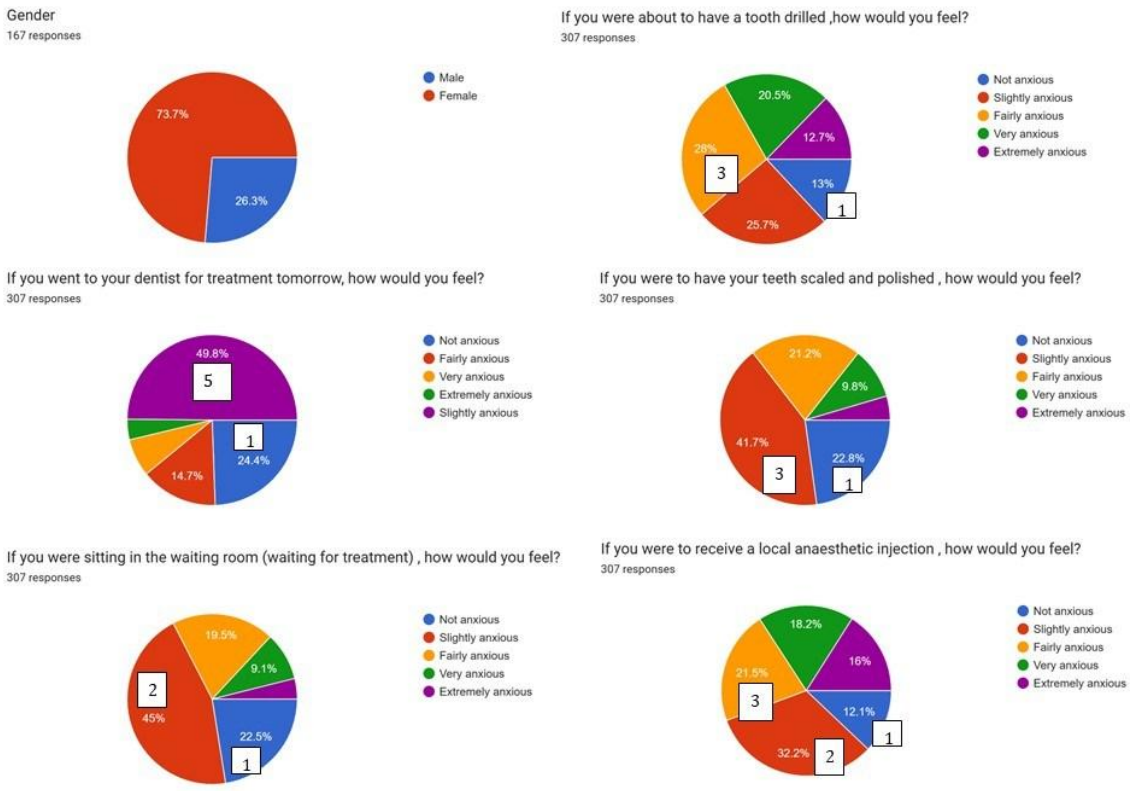
Item-wise analysis revealed that orthodontic-specific concerns were prominent among participants. High levels of agreement were observed for:

- Anticipated discomfort during separator placement (≈52%)
- Concerns regarding treatment duration (≈41%)
- Speech-related difficulties (≈47%)

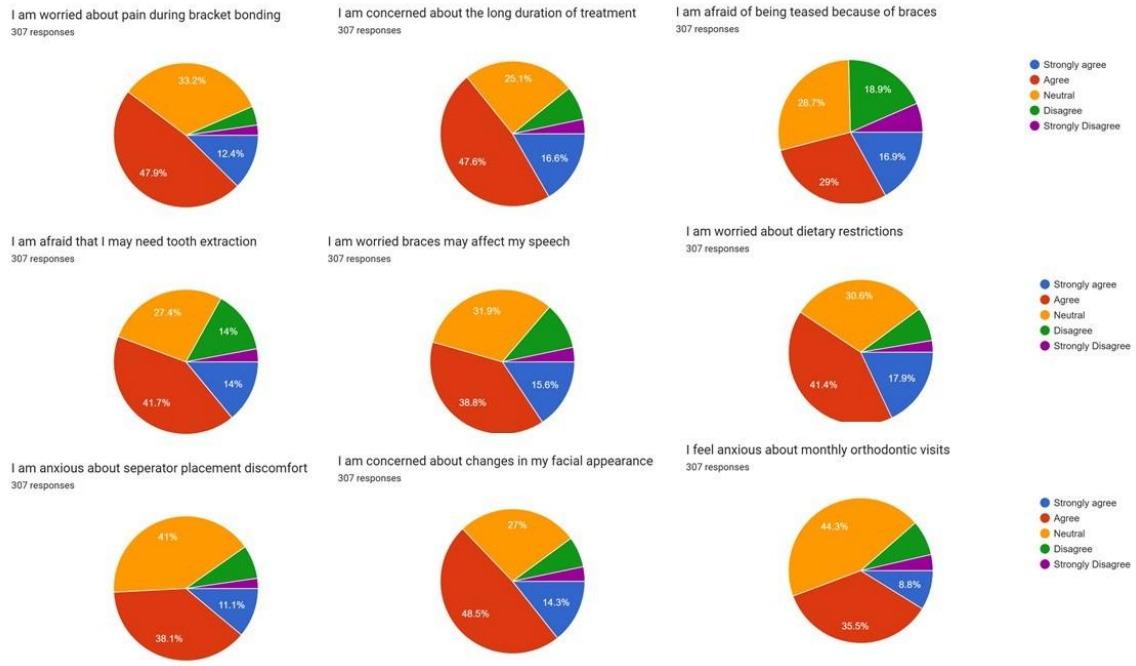
Psychosocial concerns, including fear of teasing and changes in facial appearance, demonstrated moderate variability, with a notable proportion of neutral responses. Procedural concerns related to appliance breakage and frequency of visits were present but comparatively less intense.

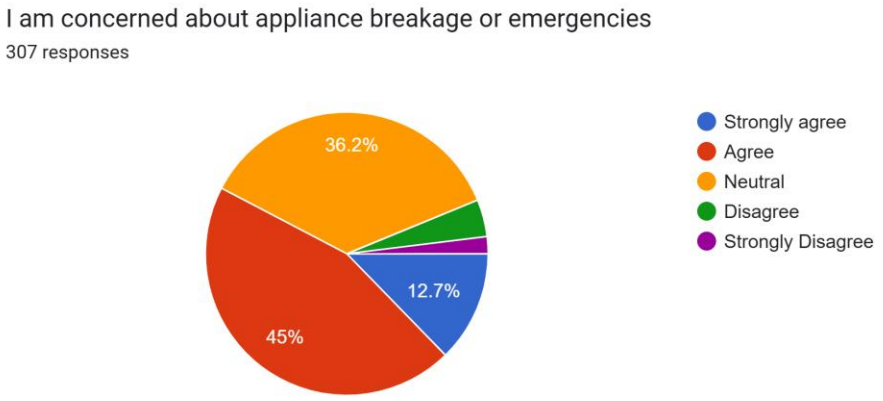
Floor and Ceiling Effects

No significant floor or ceiling effects were observed, with less than 15% of participants achieving minimum or maximum possible scores. This indicates adequate sensitivity of the OAAS in capturing varying levels of anticipatory anxiety.



Graph 1: Response to MDAS Questions





Graph 2 & 3: Response to OAAS questions

Discussion

The present study provides a comprehensive psychometric evaluation of the Orthodontic Anticipatory Anxiety Scale (OAAS) and demonstrates that orthodontic-specific anticipatory anxiety is a multidimensional construct encompassing pain-related, procedural, duration-related, and psychosocial domains. The integration of both exploratory and confirmatory factor analyses strengthens the structural validity of the instrument and supports its use as a domain-specific patient-reported outcome measure (PROM) in orthodontic settings.

Structural Validity and Psychometric Strength

The four-factor structure identified through exploratory factor analysis was further substantiated by confirmatory factor analysis, which demonstrated an acceptable to good model fit (CFI = 0.93; TLI = 0.91; RMSEA = 0.066; SRMR = 0.052). These indices meet widely accepted thresholds for structural validity, indicating that the hypothesized model adequately represents the underlying latent construct of orthodontic anticipatory anxiety. The presence of moderate inter-factor correlations suggests that

while the domains are interrelated, they retain conceptual independence, reinforcing the multidimensional nature of the construct.

From a measurement perspective, this aligns with COSMIN recommendations, which emphasize the necessity of confirming factor structure through CFA rather than relying solely on exploratory techniques. The findings therefore move the OAAS beyond preliminary validation and position it as a psychometrically robust tool suitable for clinical and research applications.

Interpretation of Moderate Convergent Validity

The observed moderate correlation ($r = 0.46$) between OAAS and general dental anxiety (MDAS) warrants careful interpretation. A stronger correlation might have suggested redundancy between the two constructs; however, the moderate magnitude observed in this study is theoretically appropriate. It indicates that while orthodontic anticipatory anxiety shares a common affective basis with general dental anxiety, it incorporates additional dimensions unique to orthodontic care, such as prolonged treatment duration, aesthetic concerns, and social implications.

This distinction is clinically relevant. General dental anxiety instruments are designed to capture acute, episodic fear responses, whereas orthodontic anxiety is characterized by anticipatory and sustained psychological engagement. Therefore, the moderate correlation supports construct specificity rather than overlap, validating the conceptual foundation of the OAAS.

Theoretical Integration: Cognitive Load Theory

The findings can be meaningfully interpreted through the lens of cognitive load theory, which posits that individuals have limited capacity for processing complex information. Orthodontic treatment, particularly at the initial consultation stage, imposes substantial cognitive demands on patients, including understanding diagnosis, treatment

options, appliance care, and long-term expectations. This cognitive burden is compounded by the need for sustained behavioral compliance over extended periods.

The identification of duration-related and procedural anxiety domains within the OAAS reflects this cognitive–emotional interaction, where informational overload contributes to anticipatory stress. Patients experiencing higher cognitive load may exhibit increased anxiety due to uncertainty, reduced comprehension, and perceived lack of control, ultimately affecting treatment acceptance and adherence.

Health Behavior Models

The results also align with established health behavior models, particularly the Health Belief Model and self-regulation frameworks. According to these models, patient behavior is influenced by perceived severity, perceived barriers, and self-efficacy. The OAAS domains—especially psychosocial and duration-related concerns—map closely onto these constructs.

For example:

- Perceived barriers: long treatment duration, discomfort
- Perceived severity: fear of pain or complications
- Self-efficacy: ability to manage appliances and maintain compliance

The ability of OAAS to capture these dimensions suggests its potential utility not only as a screening tool but also as a predictor of treatment adherence and behavioral outcomes.

Relevance in the Context of Digital Orthodontics and Tele-Orthodontics

The evolving landscape of orthodontics, characterized by the increasing adoption of digital technologies and tele-orthodontics, introduces new dimensions of patient

anxiety. Digital workflows, including intraoral scanning, virtual treatment planning, and aligner-based therapies, may reduce certain procedural anxieties but can simultaneously introduce uncertainty related to technological reliability, treatment predictability, and reduced face-to-face interaction.

Tele-orthodontics, while improving accessibility and convenience, may inadvertently amplify anticipatory anxiety in some patients due to:

- Limited direct clinician interaction
- Reduced opportunity for reassurance
- Perceived lack of immediate support during complications

In this context, a tool such as OAAS becomes particularly relevant, as it can help identify patients who may require enhanced communication, counselling, or hybrid care models combining digital and in-person approaches.

Post-COVID Behavioural Changes and Compliance

The post-pandemic era has significantly influenced patient attitudes toward long-term healthcare interventions. Increased health-related anxiety, fear of treatment interruptions, and heightened sensitivity to prolonged clinical engagement have been widely reported. Orthodontic patients, in particular, have demonstrated variable compliance patterns, influenced by concerns regarding appointment frequency, infection risk, and treatment delays.

The prominence of duration-related anxiety observed in this study may reflect these broader behavioural shifts. Patients are now more likely to evaluate treatment decisions through the lens of time burden and uncertainty, which can directly impact adherence to orthodontic protocols. The OAAS, by capturing these concerns, offers a mechanism for early identification of patients at risk of non-compliance or treatment discontinuation.

Cultural Context and Population-Specific Considerations

Cultural factors play a significant role in shaping the perception and expression of anxiety. The present study, conducted in an Indian population, reflects sociocultural influences that may differ from Western settings. For instance:

- Greater emphasis on facial aesthetics and social perception may heighten psychosocial anxiety
- Family involvement in healthcare decisions may influence anticipatory concerns
- Variations in health literacy may contribute to increased cognitive load and uncertainty

These factors may partly explain the distribution of responses observed in the psychosocial and duration-related domains. Additionally, moderate expression of anxiety (rather than extreme responses) may reflect cultural tendencies toward emotional moderation or social desirability bias. Therefore, while the OAAS demonstrates strong internal validity, its cross-cultural applicability should be further evaluated in diverse populations.

Clinical Implications

The findings of this study have direct clinical relevance. The OAAS provides clinicians with a structured, validated tool to assess orthodontic-specific anxiety prior to treatment initiation. Early identification of high-anxiety patients allows for:

- Targeted counselling and expectation management
- Use of visual aids and simplified communication to reduce cognitive load
- Behavioural interventions to improve compliance

- Personalized treatment planning, particularly in digitally mediated care environments

Incorporating OAAS into routine orthodontic assessment aligns with the broader movement toward patient-centred, psychologically informed care.

Future Directions

While the present study establishes the structural validity and internal consistency of OAAS, further research is required to:

- Evaluate test–retest reliability and longitudinal responsiveness
- Assess predictive validity for treatment compliance and outcomes
- Validate the scale across different cultural and clinical settings
- Explore integration with digital health platforms and tele-orthodontic mode

Limitations

Despite the methodological rigor and psychometric evaluation undertaken in this study, several limitations should be acknowledged when interpreting the findings.

First, the use of self-reported questionnaires introduces the possibility of response bias, as participants' answers may be influenced by individual perception, recall inaccuracies, or transient emotional states at the time of assessment. In addition, the potential for social desirability bias cannot be overlooked, particularly in a clinical setting where participants may underreport anxiety levels to align with perceived expectations of clinicians or to present themselves in a more favourable manner.

Second, although the study established internal consistency and explored the underlying factor structure, the absence of longitudinal assessment limits the ability to evaluate the stability and responsiveness of the OAAS over time. Orthodontic anxiety is a

dynamic construct that may evolve throughout different phases of treatment; therefore, the lack of follow-up data restricts insights into temporal changes and predictive validity.

Third, while exploratory factor analysis was performed to identify the dimensional structure of the scale, the lack of confirmatory factor analysis (CFA) in an independent sample limits the robustness of structural validation. Although the current findings provide preliminary support for the proposed model, external validation using advanced model-fitting techniques is necessary to establish generalizability and confirm the stability of the factor structure.

Finally, the study was conducted within a single geographic region and institutional setting, which may limit the external validity of the findings. Sociocultural factors, healthcare access, and patient expectations can vary significantly across different populations, and these factors may influence the perception and reporting of orthodontic anxiety. Therefore, caution should be exercised in generalizing the results beyond similar clinical and demographic contexts.

Future research should aim to address these limitations by incorporating multi-center designs, longitudinal follow-up, and advanced psychometric validation approaches to further strengthen the applicability and generalizability of the OAAS

Conclusion

The Orthodontic Anticipatory Anxiety Scale is a valid and reliable instrument for assessing orthodontic-specific anxiety in first-visit patients. The findings confirm that orthodontic anxiety is a multidimensional construct encompassing pain, procedural, duration-related, and psychosocial components. While related to general dental anxiety, it represents a distinct psychological domain requiring specialized assessment. The integration of OAAS into clinical practice may facilitate early identification of anxious patients and support the implementation of targeted interventions to improve treatment adherence and patient experience

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