Original Article

# LONGITUDINAL STATISTICAL MODELING OF ORTHODONTIC TREATMENT OUTCOMES AND PATIENT QUALITY OF LIFE

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**ABSTRACT**

Orthodontic treatment is expected to improve both objective occlusal relationships and patient-centered perceptions of oral function, appearance, and psychosocial well-being. This study applied longitudinal statistical modeling to evaluate how clinical orthodontic outcomes and oral health-related quality of life changed from pre-treatment through active treatment and two retention intervals. The central purpose was to determine whether early improvements in occlusion and aesthetics predicted durable quality-of-life benefits after appliance removal. A prospective cohort of patients receiving comprehensive fixed-appliance therapy was assessed at four time points: pre-treatment, debond, 12-month retention, and 24-month retention. Occlusal outcomes were measured using the Peer Assessment Rating index and the American Board of Orthodontics objective grading system. Patient-reported outcomes were captured using the Oral Health Impact Profile-14 and the Psychosocial Impact of Dental Aesthetics Questionnaire. Linear mixed-effects models were used to estimate average changes over time while accounting for repeated measurements within patients. Latent class growth analysis was applied to identify heterogeneous patterns of psychosocial response across treatment and retention. Models adjusted for baseline malocclusion severity, age, sex, treatment duration, extraction status, and baseline quality-of-life burden. The cohort showed marked improvement in occlusal scores and patient-reported quality of life at debond, with most gains maintained through 24-month retention. Mild post-retention relapse was observed in a subset of patients and was associated with small deterioration in psychosocial domains rather than large changes in functional limitation. Three quality-of-life trajectories were identified: high-improvers, moderate-improvers, and minimal-responders. The study was limited by its single-center design, 24-month retention window, and incomplete follow-up among a minority of participants. Its originality lies in simultaneously modeling objective orthodontic correction and subjective quality-of-life change across both active treatment and retention. The findings support routine integration of patient-reported outcomes into long-term orthodontic success evaluation.

**Key words:** Orthodontic treatment, Quality of life, Longitudinal modeling, Mixed-effects, Patient-reported outcomes, PAR index.

## Introduction

Orthodontic treatment is traditionally evaluated through correction of malocclusion, improved intercuspation, and post-treatment stability, yet these clinical objectives do not fully capture what patients experience during and after treatment. Systematic evidence has shown that orthodontic therapy can improve oral health-related quality of life, particularly when baseline malocclusion affects appearance, function, or social confidence [1]. Longitudinal cohort evidence also indicates that patient-perceived benefit may vary substantially across individuals, even when broadly favorable clinical outcomes are achieved [2]. For this reason, contemporary orthodontic outcome assessment requires simultaneous attention to occlusal correction and patient-centered well-being.

The retention period is especially important because treatment success depends not only on improvement at debond but also on the durability of occlusal and psychosocial gains. Long-term follow-up studies have shown that occlusal alignment and treatment outcome scores may change after appliance removal, making stability a time-dependent outcome rather than a single post-treatment endpoint [3]. Predictor studies of orthodontic stability further suggest that baseline severity, retention status, and treatment characteristics can influence post-treatment change [4]. Evidence on anterior tooth alignment during retention reinforces the need to observe outcomes beyond debond when assessing comprehensive orthodontic success [5].

Patient-reported outcomes add an additional dimension because patients may value improvements in dental appearance, confidence, comfort, and social interaction differently from clinicians. Prospective research has reported changes in self-esteem during orthodontic treatment, showing that psychosocial benefit can evolve throughout care rather than appear only at completion [6]. Comparisons of fixed appliances and clear aligners also indicate that discomfort, anxiety, and oral health-related quality of life are dynamic experiences during treatment [7]. Appliance-related quality-of-life studies have therefore

encouraged orthodontic researchers to treat patient-reported outcomes as longitudinal endpoints rather than secondary descriptive variables [8].

The objective of the present study was to model trajectories of occlusal outcomes and patient quality of life from pre-treatment to 24-month retention in a cohort treated with comprehensive fixed appliances [9-11]. Mixed-effects models were selected because they estimate average longitudinal effects while preserving individual variability in repeated clinical and patient-reported measurements [12]. Latent class growth analysis was used to identify distinct patterns of quality-of-life response, following methodological approaches developed for heterogeneous longitudinal processes [13]. The article proceeds by reviewing prior clinical, patient-reported, and statistical evidence before presenting the cohort design, modeling strategy, and baseline characteristics.

*Literature review*

Longitudinal orthodontic outcome studies have consistently emphasized that correction at the end of active treatment does not guarantee complete stability during retention. Eight-year follow-up evidence has shown that retention status is associated with the stability of orthodontic treatment outcome, supporting the clinical relevance of repeated post-treatment assessment [3]. Research using objective grading approaches has similarly indicated that occlusal outcome can vary during long-term retention, with American Board of Orthodontics-based indices capturing clinically meaningful post-treatment change [14]. Studies using PAR-based or treatment-quality measures also demonstrate that occlusal improvement and short-term stability must be interpreted as related but non-identical endpoints [15, 16].

Quality-of-life research in orthodontics has expanded the definition of treatment benefit by emphasizing functional comfort, psychological well-being, and social participation. Longitudinal evaluation among treated and untreated adolescents has shown that orthodontic therapy can improve oral health-related quality of life over time [2, 17-19]. Studies assessing changes before, during, and after treatment confirm that patient-reported outcomes may improve alongside clinical correction, but the timing and magnitude of improvement can differ by baseline burden and patient context [20]. Systematic review evidence further supports a positive association between orthodontic treatment and oral health-related quality of life while noting heterogeneity in instruments, follow-up intervals, and study designs [21].

The patient experience during orthodontic treatment is also influenced by appliance type, discomfort, anxiety, and satisfaction. Comparative studies have reported differences in quality-of-life status between patients treated with clear aligners and conventional fixed appliances [22], while early-treatment studies using fixed appliances have documented changes in pain perception, anxiety, and daily oral impacts [7]. Additional evidence from adult and adolescent cohorts shows that brackets, aligners, and other orthodontic systems can produce distinct patterns of oral health-related quality-of-life change [8, 23-25]. These findings are clinically important because fixed-appliance cohorts may experience temporary functional and psychosocial burdens before achieving post-treatment benefit.

Psychosocial and aesthetic outcomes are particularly relevant for adolescents and young adults because malocclusion can affect self-esteem, peer interaction, and perceived attractiveness. Prospective evidence has linked orthodontic care with changes in self-esteem across the treatment period [6], and longitudinal psychological studies have reported measurable quality-of-life improvement during therapy [26]. Randomized and condition-specific studies also show that correcting anterior open bite, transverse maxillary deficiency, or hypodontia-related concerns can influence oral health-related quality of life and perceived aesthetics [27-29]. Studies using malocclusion impact questionnaires and treatment-need measures further demonstrate that subjective burden is not always proportional to clinician-rated severity [30, 31].

Despite this evidence, important methodological gaps remain in the joint evaluation of clinical and patient-reported orthodontic outcomes. Many studies focus either on occlusal stability or quality-of-life improvement, while fewer models test whether early aesthetic and functional gains predict durable psychosocial benefit. Mixed-effects models are well suited to this problem because they account for clustered repeated observations and allow patient-specific deviations from the mean trajectory [12]. Latent process and latent class approaches provide an additional framework for identifying unobserved response profiles, and modern imputation methods can reduce bias when longitudinal clinical studies experience dropout [13, 32].

**Materials and Methods**

This original empirical study followed 286 patients undergoing comprehensive fixed-appliance orthodontic treatment at a university-affiliated orthodontic clinic. Patients were assessed at pre-treatment, debond, 12-month retention, and 24-month retention, reflecting the need to evaluate both active correction and post-treatment durability. The design was informed by prior evidence that quality-of-life benefit can evolve across treatment and that longer follow-up is needed to determine whether improvements persist [1, 2]. Eligibility required permanent dentition or late mixed dentition suitable for comprehensive fixed appliances, complete baseline occlusal records, and consent for repeated patient-reported outcome assessment.

Clinical outcomes were measured using the Peer Assessment Rating index and the American Board of Orthodontics objective grading system. The PAR index was used to quantify malocclusion severity and treatment improvement, consistent with prior orthodontic outcome

studies that used PAR-based assessment to evaluate treatment quality [15]. The ABO objective grading score was included because post-treatment occlusal quality and retention stability may be captured through more detailed cast-radiograph criteria [14]. Both indices were scored by calibrated examiners who were blinded to patient-reported outcome scores, reducing the risk that subjective well-being data influenced clinical grading.

Patient-reported outcomes were assessed with the OHIP-14 and PIDAQ at each visit. The OHIP-14 captured oral functional limitation, pain, psychological discomfort, and social disability, while the PIDAQ captured dental aesthetic concern, psychosocial impact, and self-confidence. Prior orthodontic quality-of-life studies have demonstrated that changes in subjective well-being may occur during treatment as well as after appliance removal [20, 33]. Psychosocial instruments were therefore treated as repeated longitudinal outcomes rather than as single pre-treatment or post-treatment descriptors, consistent with evidence on self-esteem and malocclusion impact [6, 30].

The primary analysis used linear mixed-effects models with random intercepts and random slopes for time. Time was coded categorically for pre-treatment, debond, 12-month retention, and 24-month retention so that nonlinear changes could be estimated without assuming a strictly linear response. Fixed effects included visit, baseline PAR score, baseline ABO score, age, sex, extraction status, treatment duration, and baseline OHIP-14 or PIDAQ score, reflecting earlier findings that clinical severity and patient characteristics may influence orthodontic outcomes [4, 5]. Model selection followed mixed-model recommendations for clustered repeated clinical data, emphasizing interpretable fixed effects and variance components rather than cross-sectional comparisons alone [12].

Latent class growth analysis was then used to identify subgroups with distinct quality-of-life trajectories. Candidate models with two to five classes were compared using information criteria, class size, posterior classification probability, and clinical interpretability, following latent process modeling principles [13]. Missing outcome data were handled by maximum likelihood estimation under a missing-at-random assumption, with sensitivity checks based on model-based imputation strategies for longitudinal and multilevel data [32]. This approach allowed patients with incomplete retention data to contribute available observations while reducing bias from listwise deletion.

**Figure 1** illustrates the longitudinal orthodontic cohort design, repeated outcome assessments, and integrated mixed-effects and latent class growth modeling workflow.

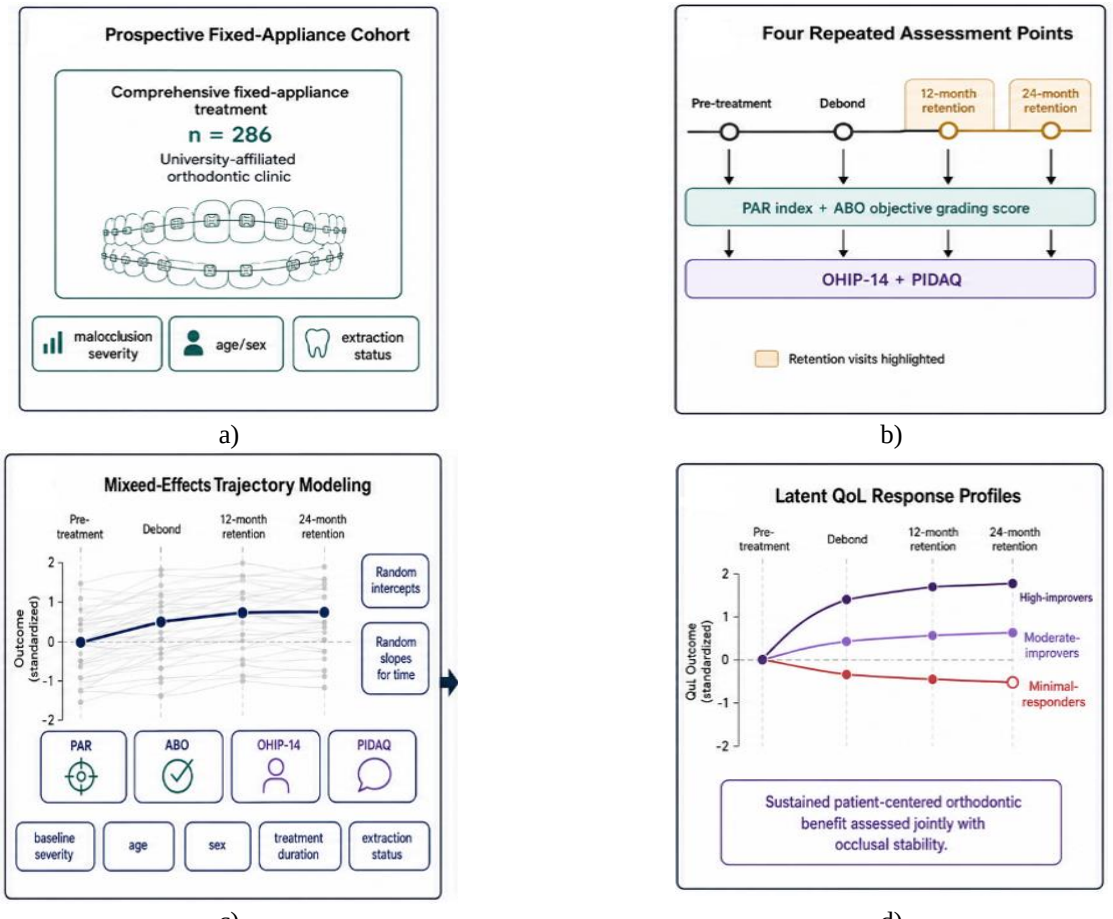


**Figure 1.** Longitudinal Orthodontic Cohort Design and Integrated Statistical Modeling Framework for Occlusal and

Baseline characteristics indicated a clinically heterogeneous cohort with variation in malocclusion severity, treatment duration, extraction status, and psychosocial burden. **Table 1** presents baseline demographic and clinical characteristics of the longitudinal cohort. The descriptive structure was designed to show whether patients retained through each assessment phase were broadly comparable to the original baseline cohort, which is important because retention studies may be affected by differential follow-up [3, 16]. Baseline distributions were also used to contextualize later mixed-effects and latent class findings.

**Table 1.** Baseline Characteristics of the Orthodontic Cohort across Treatment and Retention Phases

| Characteristic | Pre-treatment cohort (n = 286) | Observed at debond (n = 274) | Observed at 12-month retention (n = 262) | Observed at 24-month retention (n = 251) |
|---|---|---|---|---|
| **Age, years, mean ± SD** | 15.8 ± 3.4 | 15.7 ± 3.3 | 15.8 ± 3.2 | 15.9 ± 3.3 |
| **Female, n (%)** | 166 (58.0) | 159 (58.0) | 151 (57.6) | 146 (58.2) |
| **Class I malocclusion, n (%)** | 112 (39.2) | 108 (39.4) | 103 (39.3) | 99 (39.4) |
| **Class II malocclusion, n (%)** | 128 (44.8) | 122 (44.5) | 116 (44.3) | 111 (44.2) |
| **Class III malocclusion, n (%)** | 46 (16.1) | 44 (16.1) | 43 (16.4) | 41 (16.3) |
| **Extraction treatment, n (%)** | 82 (28.7) | 79 (28.8) | 76 (29.0) | 72 (28.7) |
| **Baseline PAR score, mean ± SD** | 31.6 ± 8.9 | 31.4 ± 8.7 | 31.2 ± 8.8 | 31.1 ± 8.6 |
| **Baseline ABO score, mean ± SD** | 42.8 ± 10.6 | 42.5 ± 10.4 | 42.4 ± 10.5 | 42.2 ± 10.3 |
| **Baseline OHIP-14 score, mean ± SD** | 21.7 ± 7.4 | 21.5 ± 7.3 | 21.4 ± 7.2 | 21.3 ± 7.1 |
| **Baseline PIDAQ score, mean ± SD** | 48.9 ± 14.2 | 48.5 ± 14.0 | 48.2 ± 13.9 | 48.0 ± 13.8 |
| **Planned treatment duration, months, mean ± SD** | 22.4 ± 5.7 | 22.3 ± 5.6 | 22.2 ± 5.5 | 22.2 ± 5.4 |
| **Fixed retainer prescribed, n (%)** | 236 (82.5) | 228 (83.2) | 219 (83.6) | 210 (83.7) |

## Results and Discussion

The baseline cohort included 286 patients, with 251 patients contributing observations through the 24-month retention visit. Patients who remained under observation had baseline PAR, ABO, OHIP-14, and PIDAQ scores similar to the full cohort, suggesting limited evidence of major attrition bias in measured baseline variables. This pattern is important because orthodontic retention studies have shown that post-treatment follow-up can shape conclusions about stability and durability of treatment benefit [3]. The cohort therefore provided adequate longitudinal structure for modeling both clinical correction and patient-reported change over time [34-36].

Mean PAR scores declined from 31.6 at pre-treatment to 7.8 at debond, 8.6 at 12-month retention, and 9.4 at 24-month retention. Mean ABO scores declined from 42.8 at pre-treatment to 15.2 at debond, followed by modest increases to 16.4 and 17.3 at the 12- and 24-month retention visits. These findings are consistent with previous work showing strong occlusal improvement after comprehensive orthodontic treatment but measurable post-treatment change during retention [11, 12]. Quality-of-life scores improved in parallel, with OHIP-14 decreasing from 21.7 to 8.9 at debond and remaining lower than baseline at 24 months, while PIDAQ decreased from 48.9 to 22.6 at debond and 25.4 at 24-month retention.

The mixed-effects models confirmed significant fixed effects of time for all four outcomes after adjustment for baseline severity, age, sex, extraction status, and treatment duration. **Table 2** reports the fixed-effect estimates and variance components from the mixed-effects models for occlusal and quality-of-life outcomes. Time effects were strongest from pre-treatment to debond, whereas the 12- and 24-month retention coefficients showed small attenuation of benefit rather than reversal of treatment effect. The presence of significant random intercepts and random slopes supported the use of mixed-effects modeling rather than simple paired comparisons, consistent with repeated-measures recommendations for clustered patient data [12].

**Table 2**. Longitudinal Mixed-Effects Model Estimates for Occlusal Outcomes and Quality of Life Trajectories

| Outcome and model parameter | Estimate | 95% CI | p-value | Interpretation |
|---|---|---|---|---|
| **PAR: debond vs pre-treatment** | −23.8 | −25.1 to −22.5 | <0.001 | Large occlusal improvement after active treatment |
| **PAR: 12-month retention vs pre-treatment** | −23.0 | −24.4 to −21.7 | <0.001 | Improvement largely maintained |

| | | | | |
|---|---|---|---|---|
| **PAR: 24-month retention vs pre-treatment** | −22.2 | −23.7 to −20.8 | <0.001 | Mild relapse but sustained net improvement |
| **ABO: debond vs pre-treatment** | −27.6 | −29.3 to −25.9 | <0.001 | Strong improvement in objective grading score |
| **ABO: 24-month retention vs pre-treatment** | −25.5 | −27.4 to −23.6 | <0.001 | Retained improvement with modest deterioration |
| **OHIP-14: debond vs pre-treatment** | −12.8 | −14.1 to −11.6 | <0.001 | Improved oral health-related quality of life |
| **OHIP-14: 24-month retention vs pre-treatment** | −10.9 | −12.3 to −9.5 | <0.001 | Sustained quality-of-life benefit |
| **PIDAQ: debond vs pre-treatment** | −26.3 | −28.7 to −23.8 | <0.001 | Reduced psychosocial impact of dental aesthetics |
| **PIDAQ: 24-month retention vs pre-treatment** | −23.5 | −26.1 to −20.8 | <0.001 | Durable psychosocial improvement |
| **Baseline PAR effect on 24-month PAR** | 0.31 | 0.18 to 0.44 | <0.001 | Greater initial severity predicted higher residual PAR |
| **Baseline PIDAQ effect on 24-month PIDAQ** | 0.42 | 0.29 to 0.55 | <0.001 | Higher initial psychosocial burden predicted persistent burden |
| **Random intercept variance: PAR** | 18.6 | 14.8 to 23.7 | — | Between-patient heterogeneity in occlusal level |
| **Random slope variance: OHIP-14 time** | 5.9 | 3.7 to 8.8 | — | Between-patient heterogeneity in QoL change |
| **Residual variance: PIDAQ** | 31.4 | 27.2 to 36.9 | — | Within-patient unexplained psychosocial variation |

**Figure 2** summarizes the main longitudinal findings for occlusal improvement, quality-of-life change, latent response classes, and the relationship between post-retention relapse and psychosocial burden.

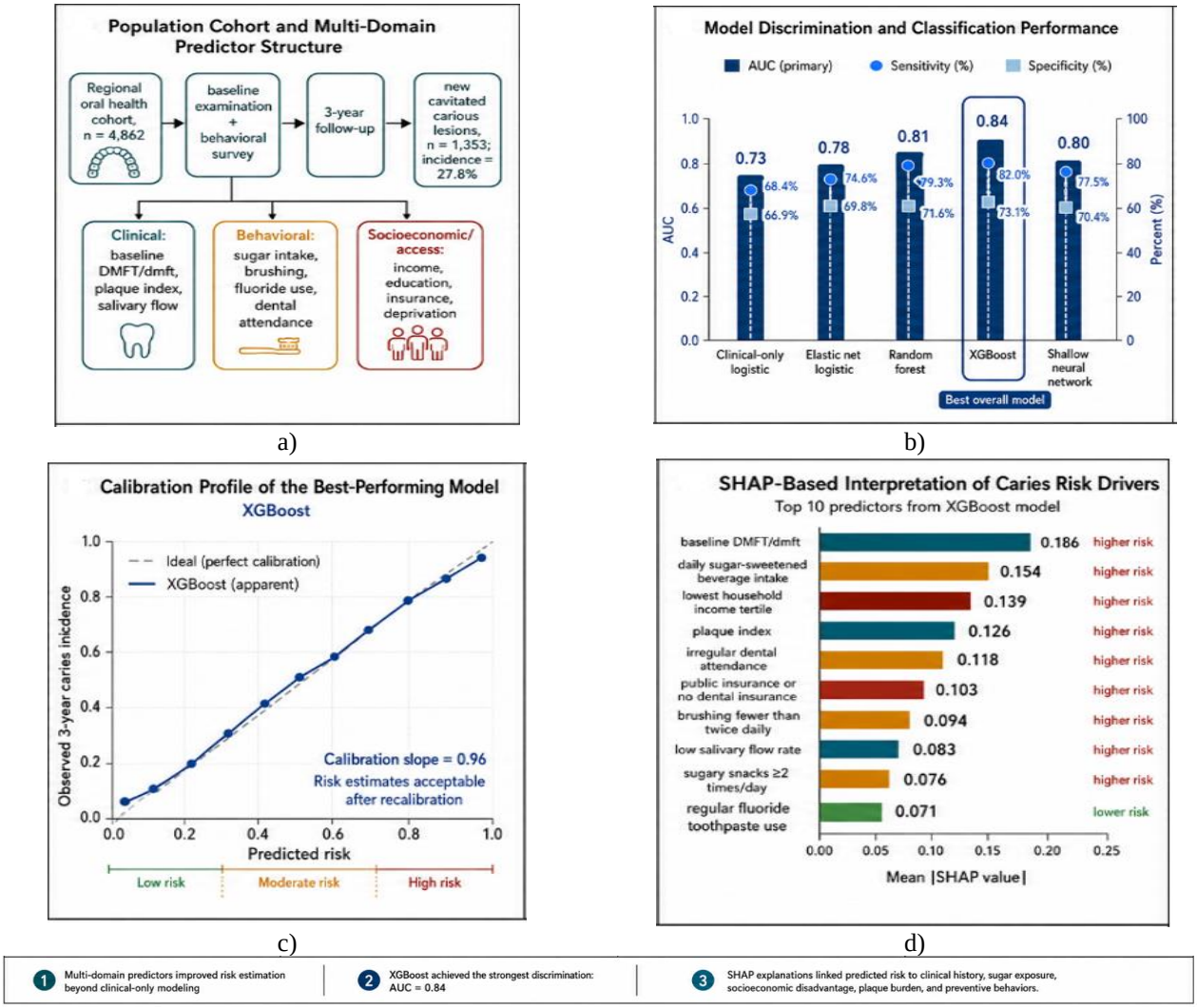

**Figure 2.** Longitudinal Occlusal Improvement, Quality-of-Life Trajectories, and Latent Response Classes across Orthodontic Treatment and Retention

Latent class growth analysis identified three quality-of-life response classes. The high-improver class represented 42.3% of the cohort and showed large reductions in OHIP-14 and PIDAQ scores by debond, with maintenance through retention. The moderate-improver class represented 39.5% and showed steady but smaller improvements, while the minimal-responder class represented 18.2% and retained elevated psychosocial scores despite objective occlusal correction. This heterogeneity aligns with evidence that orthodontic treatment improves quality of life on average, but patient-specific response patterns vary across appliance types, baseline concerns, and psychosocial profiles [37-40].

Higher baseline PIDAQ score, greater dental aesthetic concern, and lower baseline self-confidence predicted membership in the high-improver class, whereas elevated baseline anxiety and weaker perceived treatment expectations predicted minimal response. Mild 24-month increases in PAR and ABO scores were associated with small but significant worsening in PIDAQ psychosocial impact, although the association with OHIP-14 functional limitation was weaker. This pattern is consistent with studies showing that self-esteem, anxiety, and subjective malocclusion impact can shape patient-reported orthodontic benefit independently of clinician-rated correction [6, 30, 41]. Extraction status was not independently associated with quality-of-life trajectory after baseline severity and treatment duration were included in the model.

The findings indicate that comprehensive fixed-appliance treatment produced substantial improvements in occlusal outcomes and patient quality of life, with most benefits maintained through 24-month retention. The magnitude of PAR and ABO improvement supports the clinical effectiveness of active treatment, while the sustained reduction in OHIP-14 and PIDAQ scores confirms that treatment success extended beyond technical occlusal correction. These findings agree with systematic and longitudinal evidence that orthodontic treatment can improve oral health-related quality of life when malocclusion affects appearance, comfort, or social participation [1, 2]. The 24-month pattern also supports more recent longitudinal work showing that quality-of-life gains can remain clinically meaningful after treatment completion [37].

The modest relapse observed during retention did not eliminate the overall treatment benefit, but it was clinically relevant because deterioration in occlusal scores correlated with worsening psychosocial impact. This result is consistent with retention evidence showing that post-treatment occlusal changes continue after debond and must be monitored as part of outcome evaluation [3, 5]. ABO-based stability research has similarly shown that objective grading scores can vary over time, reinforcing the need for repeated measurement during retention rather than reliance on a single post-treatment endpoint [14]. The present study extends this literature by showing that even mild relapse may matter to patients when it affects perceived dental appearance or confidence.

The latent class findings show that average treatment effects can conceal meaningful heterogeneity in patient response. Patients in the high-improver class appeared to experience orthodontic treatment as a major psychosocial intervention, whereas minimal-responders showed persistent quality-of-life burden despite clinical improvement. This interpretation is compatible with evidence that appliance experience, pain, anxiety, and treatment modality can shape patient-reported outcomes during orthodontic care [7, 8, 22, 42]. Randomized and comparative studies of aligners and fixed appliances further show that clinical correction and patient experience are related but separable dimensions of treatment success [24, 25].

Baseline psychosocial burden was one of the strongest predictors of long-term quality-of-life trajectory. This result is consistent with studies linking orthodontic treatment to changes in self-esteem, psychological well-being, and malocclusion-related social concern [6, 26]. It also supports the view that patient-reported outcome instruments capture aspects of treatment need that may not be fully represented by clinician-rated severity indices [30, 31]. Findings from condition-specific and aesthetic-treatment studies likewise suggest that patients with high appearance-related burden may derive substantial psychosocial benefit when treatment addresses the concern that motivated care [29, 40].

*Implications*

Clinically, these results support the routine use of baseline quality-of-life and psychosocial screening before comprehensive orthodontic treatment. Patients with high aesthetic concern may experience large psychosocial benefit, but patients with anxiety or persistent negative self-perception may need more careful counseling during treatment. Evidence that orthodontic treatment influences psychological health and patient-reported well-being supports integrating these measures into clinical assessment rather than treating them as optional research outcomes [6, 33]. Such screening may help orthodontists set realistic expectations and identify patients who require additional communication during active treatment and retention.

Retention planning should also be individualized because mild relapse was associated with deterioration in psychosocial domains. Previous stability research has shown that retention status, baseline severity, and treatment characteristics can influence post-treatment occlusal change [3, 4]. The present findings suggest that retention protocols should consider not only the probability of clinical relapse but also the likely patient-perceived impact of relapse. This is especially relevant for patients whose initial treatment

motivation is strongly related to dental aesthetics or social confidence, because small anterior changes may carry disproportionate psychosocial meaning [5, 16].

Methodologically, the study demonstrates the value of jointly modeling clinical and patient-reported orthodontic outcomes using longitudinal frameworks. Mixed-effects models allowed estimation of population-average treatment effects while retaining individual deviations, and latent class growth analysis identified clinically meaningful response subgroups [12, 13]. The use of likelihood-based handling of incomplete repeated observations also reflects best practice for longitudinal clinical data with dropout [32]. Future orthodontic studies can build on this framework by linking clinical indices, patient-reported outcomes, retention adherence, and treatment satisfaction in one integrated model.

*Limitations and future research*

The study was limited by its single-center design and 24-month retention period. Although baseline comparability across follow-up groups reduced concern about severe attrition bias, unmeasured differences between retained and lost participants may still have influenced estimates. Previous orthodontic quality-of-life studies have shown that findings can vary by setting, population, age group, and instrument selection [7, 13]. Multi-center cohorts with longer follow-up would improve generalizability and help determine whether the observed trajectories persist beyond the early retention period.

The study also relied on self-reported OHIP-14 and PIDAQ responses, which may be influenced by mood, expectations, social desirability, and adaptation to treatment. Psychosocial measures are essential for patient-centered orthodontic evaluation, but they do not replace clinical judgment or detailed assessment of occlusion and function. Prior research using malocclusion impact and treatment-need instruments has shown that subjective burden may diverge from clinician-rated severity [30, 31]. Future work should combine self-report, clinician assessment, digital occlusal analysis, and qualitative patient interviews to clarify why some patients remain minimal-responders despite objectively successful treatment.

Future research should also compare retention protocols, appliance systems, and malocclusion subtypes using harmonized longitudinal outcome batteries. Trials and cohort studies of open bite correction, rapid palatal expansion, hypodontia care, aligner treatment, and fixed appliances suggest that quality-of-life change may differ by clinical condition and treatment pathway [24, 25, 27-29]. Recent studies of aligners, open bite spurs, and adult orthodontic systems further indicate that discomfort, adaptation, and psychosocial benefit should be assessed repeatedly rather than inferred from endpoint outcomes alone [38-40]. Longer observation will be necessary to determine whether sustained patient benefit depends primarily on occlusal stability, perceived aesthetics, retention adherence, or broader psychosocial adaptation.

**Conclusion**

This study showed that longitudinal statistical modeling can clarify how orthodontic treatment success develops across active treatment and retention. Objective occlusal indices improved substantially at debond and remained markedly better than baseline at 24-month retention, although mild relapse was detectable. Patient-reported quality-of-life measures improved in parallel, demonstrating that comprehensive fixed-appliance treatment can produce durable clinical and psychosocial benefit.

The results also showed that patients do not follow one uniform quality-of-life pathway. Three trajectory classes were identified, indicating that some patients experience rapid and sustained psychosocial improvement, while others report only moderate or minimal benefit. Baseline psychosocial burden and perceived dental aesthetic impact were central to these differences, supporting a more individualized approach to orthodontic outcome evaluation.

Overall, the study supports routine monitoring of patient-reported outcomes alongside PAR and ABO indices in long-term orthodontic assessment. Orthodontic success should be defined not only by the technical quality of occlusal correction but also by the stability of improvements that patients can feel in daily life. Integrating clinical indices with quality-of-life measures can help clinicians, researchers, and patients define treatment success in a more complete and patient-centered way.

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