Effects of malocclusion and its treatment on the quality of life of adolescents

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Introduction: The relationship between malocclusion and quality of life (QoL) is complex and not well understood. The objective of this study was to determine whether malocclusion and its treatment influence an adolescent’s general and oral health-related QoL. Methods: An observational, cross-sectional design with a longitudinal component was used. Clinical and self-reported data were collected from 293 participants aged 11 to 14. The children were recruited from orthodontic and pediatric dental clinics at the University of Washington and a community health clinic in Seattle. The participants were classified into precomprehensive orthodontic (n = 93), postinterceptive orthodontic (n = 44), and nonorthodontic comparison (n = 156) groups. Assessments of dental esthetics and occlusion were evaluated with the Index of Complexity, Outcome, and Need. Three QoL questionnaires were completed: Youth Quality of Life to assess general QoL, Children’s Oral Health-Related Quality of Life to assess oral health QoL, and Treatment Expectations and Experiences to evaluate participants’ expectations for changes in specific aspects of their lives. Nonparametric tests were used for all analyses. Results: In general, overall and oral health QoL were high in this population. The instruments were correlated so that when oral health QoL improved, so did general QoL. No differences were found in these measurements between the university and community health clinics. Nor were there differences between the 3 study groups on general QoL and oral health QoL. There was little effect of malocclusion complexity on any QoL measure. Both preorthodontic and postorthodontic participants expected improvements in their health, oral function, appearance, and social well-being after orthodontic treatment; the postinterceptive sample’s posttreatment experiences were consistent with their pretreatment expectations in all domains. Conclusions: Malocclusion and orthodontic treatment do not appear to affect general or oral health QoL to a measurable degree, despite subjective and objective evidence for improved appearance, oral function, health, and social well-being. (Am J Orthod Dentofacial Orthop 2009;136:382-92)
the decision to have treatment is based not only on the severity of malocclusion, but also on children’s and parents’ desires to improve the child’s appearance and self-concept. Research has only recently begun to address whether these expectations about the benefits of orthodontic treatment are warranted.

Recent studies with standardized instruments have shown a link between malocclusion and OHQoL. Researchers in New Zealand assessed the association between OHQoL and malocclusion severity in 430 adolescents aged 12 to 13. The results showed a distinct OHQoL gradient with varying severities of malocclusion. Children in the “handicapping” category of malocclusion scored lower on a measure of OHQoL than those in the “minor/no malocclusion” category; these differences emerged only in the emotional and social well-being domains and not in the areas of oral symptoms or functional limitations. Locker et al. also reported an association between OHQoL and an objective measurement of occlusion. They found a significant relationship between OHQoL measures and the child’s self-ratings of oral health. Furthermore, the type of malocclusion, such as anterior spacing or increased overjet seemed to affect OHQoL. In contrast, Oliveria et al. found that a child’s perceived need for orthodontic treatment was supported by OHQoL measures, but not by an objective measure of occlusion. Although it appears that malocclusion can have an impact on children’s OHQoL, the relationship between objective treatment outcome measures and QoL is not clear and direct.

Researchers have reported varied effects of orthodontic treatment on QoL. A study in Brazil reported improvements in OHQoL after orthodontic intervention. There were improvements in OHQoL for subjects who had completed orthodontic treatment and those currently in orthodontic treatment, compared with those who had not had treatment (1.85 and 1.43 times greater, respectively). Similarly, Vig et al. found improved OHQoL in adolescents after they began orthodontic treatment. A 20-year observational study found that patients with significant malocclusions in adolescence who had orthodontic treatment were more satisfied with their dental occlusion, had higher self-esteem, and had higher QoL compared with those with untreated needs. However, when baseline self-esteem levels were accounted for, improvement in self-esteem and QoL disappeared. This study concluded that malocclusion has no discernable long-term effect on self-esteem and QoL, and that orthodontic treatment has no positive impact on psychological well-being.

Several QoL questionnaires have been developed in recent years. The Children’s Oral Health Related Quality of Life questionnaire (COHQoL) was formulated specifically for assessing the impact of oral conditions on children’s QoL. Jokovic et al. measured OHQoL in children with various dental, orthodontic, and orofacial conditions. The COHQoL questionnaire represents 4 domains of OHQoL: oral symptoms, functional limitations, emotional well-being, and social well-being. In a recent article reviewing QoL and orthodontics, the authors stated that the robust COHQoL will probably become the instrument of choice for orthodontic QoL research.

In a review of the literature, we found no studies of the association between orthodontic treatment and overall QoL. The Youth Quality of Life (YQoL) instrument was designed to measure general QoL in adolescents. It has been validated with adolescents aged 11 to 18 years with many health conditions but has not been reported in the orthodontic population. It measures QoL in 4 domains: social relationships, sense of self, environment, and general quality of life. This questionnaire addresses more global aspects of an adolescent’s life than does a questionnaire that focuses specifically on OHQoL. It is unknown whether orthodontic treatment can affect general QoL.

The COHQoL and YQoL are generic instruments that do not ask participants specifically about their malocclusion and orthodontic treatment. The Treatment Expectations and Experiences questionnaire is an alternative means of measuring QoL by asking patients about their pretreatment expectations and posttreatment experiences related to orthodontics. For this reason, this it is a more specific indicator of QoL related to treatment. Although the original instrument was created for orthognathic surgery patients, it has been modified for use with conventional orthodontic populations and younger patients. It consists of 4 domains: oral function, social interaction, general health, and self-image (esthetics). To date, there has been little research on the association between scores on this treatment expectations and experiences scale and measures of QoL.

Because of the conflicting findings of previous studies, the purpose of this clinical research was to investigate whether malocclusion and orthodontic treatment influence an adolescent’s general and OHQoL. Our specific research questions were the following:

1. Do dental patients from a community health clinic differ in their QoL and OHQoL from those at a university clinic? It was hypothesized that the patients in a community health clinic would have a lower general QoL than those at a university clinic but overall OHQoL would be similar in the 2 groups.
2. How are OHQoL and general QoL related? It was hypothesized that there would be a significant association between OHQoL and general QoL.
3. What is the relationship between OHQoL, general QoL, treatment expectations, and objectively assessed malocclusion? It was hypothesized that children with higher OHQoL and general QoL would have lower treatment expectations than those with lower levels of OHQoL and QoL. Because objective levels of malocclusion are generally unrelated to patients’ perceptions of severity, we hypothesized that there would be no significant associations between this objective measure and the 3 subjective measures.

4. Is there a difference in OHQoL and QoL between patients who are planning to have orthodontic treatment vs those who have completed treatment, and do they differ from dental patients not seeking orthodontic care? It was hypothesized that children who have completed treatment would report higher OHQoL and general QoL than those preparing for treatment and would not differ from children who did not seek orthodontic treatment. This latter group was expected to have higher OHQoL and QoL scores than the pretreatment children.

5. Do patients’ pretreatment orthodontic expectations match their self-assessed posttreatment results, and do these evaluations correlate with objectively assessed changes in occlusion? We hypothesized that children with extremely high expectations from treatment would report moderate to high levels of satisfaction with outcomes, scoring higher on treatment experiences than their expectation scores. Higher self-assessments were expected from children with objectively assessed improvements in their occlusion.

MATERIAL AND METHODS

Our subjects were recruited from 2 sites—the University of Washington School of Dentistry (UW) and the Odessa Brown Children’s Clinic (OBCC), a community health clinic in the Seattle area. At UW, the participants were recruited from the Graduate Orthodontic Clinic and the Graduate Pediatric Dentistry Clinic. At OBCC, the patients were recruited from the orthodontic and pediatric dentistry clinics.

The orthodontic participants from OBCC were part of a larger randomized clinical trial (RCT), an ongoing study evaluating the impact of interceptive vs comprehensive treatment for Medicaid-funded children. Subjects for this RCT were between the ages of 9 and 11 who were all determined to be candidates for interceptive orthodontic treatment; they were randomly assigned to 1 of 2 interventions. The first intervention was 2 years of interceptive treatment during the mixed dentition stage, followed by 2 years of observation. The second intervention was 2 years of observation after randomization, followed by 2 years of comprehensive treatment. The subjects in the RCT were compared across these stages of observation and treatment, but these time points were unrelated to the assessments in this study. All interceptive treatment patients received treatment at OBCC, and all comprehensive treatment patients were scheduled to receive treatment at UW. The subjects in the RCT all received Medicaid support for their orthodontic treatment.

Both clinical and self-reported data were collected from 293 volunteers aged 11 to 14 years. The composition of the subjects at each site is reported in Table I. Generally, boys and girls were equally distributed, with an average age of almost 13 years. The subjects were consecutively treated in their respective clinics. No participant, except for the postinterceptive treatment ones, had received previous orthodontic treatment. The following groups were compared.

1. Precomprehensive orthodontic participants (precomprehensive): the precomprehensive group included patients who needed orthodontic treatment but had not yet started it. As shown in Table I, 2 groups of precomprehensive orthodontic patients were recruited for this study; both are patients of record at the UW Orthodontic Graduate Clinic and had come for comprehensive treatment. The first subset of precomprehensive participants was from the UW general orthodontic patient population; most were private pay patients. The second subset was recruited from the RCT at OBCC; they were scheduled for comprehensive treatment at the UW Orthodontic Graduate Clinic after 2 years of observation. All precomprehensive patients answered questionnaires before the start of orthodontic treatment (ie, before their treatment consultation appointment).

2. Postinterceptive orthodontic participants (postinterceptive): the postinterceptive group included patients who were evaluated as needing orthodontic treatment and had completed it before entering this study. All postinterceptive participants were recruited from the RCT. They had completed treatment at OBCC and were currently in the 2-year postorthodontic observation phase. The RCT required that interceptive treatment for each subject be carried out until the treatment objectives were met, up to a maximum of 2 years.

The original intention was to include a postorthodontic treatment group from the general UW Orthodontic Clinic, but the 11-to-14 year age range for this study
limited the number of eligible subjects, making this subset impractical.

The postinterceptive participants answered questionnaires at a recall appointment at least 1 month after active orthodontic treatment (mean time after debond, 7.61 ± 7.77 months).

3. Pediatric dental participants (comparison): 2 groups of pediatric dental patients were the comparison group in this study. The first included 72 patients of record at the UW Graduate Pediatric Dental Clinic; the second included 84 patients of record at OBCC. None had orthodontic appliances; they and their parents denied ever having had orthodontic treatment or plans for orthodontic treatment. These subjects answered questionnaires before their routine dental appointments. In addition, an intraoral frontal photograph was taken to evaluate occlusion esthetics.

Because QoL is complex, multifaceted, and depends on psychological maturity, it has been difficult to measure in young, developing patients. Recently, QoL instruments have been developed to assess this concept in pediatric and adolescent populations. We used 2 instruments designed specifically for younger persons. A third instrument, Kiyak’s Treatment Expectation and Experience scales, indirectly measures QoL-related issues by asking patients to rate specific aspects of their lives that they expect will improve with orthodontic treatment and then asks them after treatment to what extent their expectations were met.

All subjects completed 2 QoL questionnaires: the COHQoL and the YQoL. The comparison group received only these 2 questionnaires. The preorthodontic participants also completed the Treatment Expectations questionnaire before starting orthodontic treatment as part of their testing in the RCT. The postinterceptive participants were also administrated the treatment experiences questionnaire at the same time as the YQoL and COHQoL.

The questionnaires were given in random order. A research assistant read the directions with the child and was available to clarify any questions. Otherwise, the participants completed the questionnaires independently; parents were not present during this assessment. Figure 1 summarizes the instruments administered to each study group.

The YQoL instrument was used to assess general QoL. It contains 40 questions. Two items were removed from the original questionnaire because they were not appropriate for many adolescents in the age range of this sample. These questions involved comfort levels with sexual feelings and behaviors and personal beliefs providing strength. The questions are measured on an

### Table I. Sex, ethnicity, and severity of malocclusion in the 3 groups

<table>
<thead>
<tr>
<th></th>
<th>Precomprehensive treatment</th>
<th>Precomprehensive treatment</th>
<th>Precomprehensive group</th>
<th>Postinterceptive treatment</th>
<th>Postinterceptive treatment</th>
<th>Postinterceptive group</th>
<th>Comparison</th>
<th>Comparison</th>
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</thead>
<tbody>
<tr>
<td>Clinic</td>
<td>UW</td>
<td>OBCC (RCT)</td>
<td>Combined</td>
<td>OBCC (RCT)</td>
<td>UW</td>
<td>OBCC</td>
<td>Combined</td>
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<td>n</td>
<td>49</td>
<td>44</td>
<td>93</td>
<td>44</td>
<td>72</td>
<td>84</td>
<td>156</td>
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</tr>
<tr>
<td>Sex (% male)</td>
<td>23 (46.9%)</td>
<td>25 (56.8%)</td>
<td>48 (51.6%)</td>
<td>23 (52.2%)</td>
<td>38 (52.8%)</td>
<td>42 (50.0%)</td>
<td>80 (51.3%)</td>
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<tr>
<td>Age (M ± SD)</td>
<td>13 y 0 mo ± 1.1</td>
<td>12 y 2 mo ± 1.1</td>
<td>12 y 6 mo ± 1.1</td>
<td>12 y 6 mo ± 1.1</td>
<td>12 y 8 mo ± 1.1</td>
<td>12 y 9 mo ± 1.2</td>
<td>12 y 9 mo ± 1.1</td>
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<tr>
<td>Ethnicity</td>
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<tr>
<td>White (%)</td>
<td>67.3</td>
<td>18.2</td>
<td>44.1</td>
<td></td>
<td></td>
<td>18.2</td>
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<td>Hispanic</td>
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<td>11.4</td>
<td>9.7</td>
<td>22.7</td>
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<tr>
<td>Black</td>
<td>2</td>
<td>31.8</td>
<td>16.1</td>
<td>27.3</td>
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<tr>
<td>Asian</td>
<td>12.2</td>
<td>25</td>
<td>18.3</td>
<td>22.7</td>
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<td></td>
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<tr>
<td>Other</td>
<td>10.2</td>
<td>13.6</td>
<td>11.8</td>
<td>9</td>
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<tr>
<td>Pre-ICON total*</td>
<td>63.8 ± 20.2</td>
<td>74.7 ± 21.7</td>
<td>69.0 ± 21.5</td>
<td>79.0 ± 20.1</td>
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<tr>
<td>Pre-ICON esthetic†</td>
<td>5.9 ± 2.1</td>
<td>7.4 ± 2.2</td>
<td>6.6 ± 2.2</td>
<td>7.8 ± 1.8</td>
<td>4.1 ± 1.8</td>
<td>4.0 ± 1.9</td>
<td>4.0 ± 1.9</td>
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<tr>
<td>Post-ICON total*</td>
<td></td>
<td></td>
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<td></td>
<td>48.9 ± 21.4</td>
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<tr>
<td>Post-ICON esthetic†</td>
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<td>4.6 ± 2.2</td>
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</table>

*M, Mean; Other, not reported or a combination of several ethnicities.
*Possible range, 7-120; †Possible range, 0-10.
11-point rating scale ranging from 0 (not at all) to 10 (completely). A score is determined for each subscale (social relationships, sense of self, environment, and general QoL) and an overall score. By using the methodology specified by the developers of the YQoL, the scores were transformed to a 100-point scale: a higher score indicates better general QoL.24,26,28,29

OHQoL was measured with the COHQoL.22 Because of their ages, our subjects completed the 11-to-14 year-old version of the Child Perceptions Questionnaire portion of the COHQoL, consisting of 39 questions. Scores were calculated by summing the response codes (0-4) across 37 of the 39 items. In addition, 2 overall well-being questions were not part of the total score; these questions asked the subjects to rate the condition of their teeth, lips, and mouth (oral-health item) and its impact on life overall (oral-impact item). The results were converted to a 100-point scale; unlike the YQoL, lower scores indicated better QoL.32 Total and domain scores (oral symptoms, functional limitations, emotional well-being, and social well-being) were obtained.

As an alternative means of measuring QoL, we used a third instrument, the Treatment Expectations and Experiences questionnaire. It consists of 14 questions in 4 domains (oral function, social interaction, general health, and self-image). A 7-point response scale accompanies each item, ranging from -3 (“will be worse after treatment”) to +3 (“will be better after treatment”). A score of 0 indicates that no change is expected. To assess the experiences of patients who completed active orthodontic treatment, the Treatment Expectations questionnaire has verbal anchors of “is worse” and “is better” after orthodontic treatment. Each domain consists of 4 items, except for the general health dimension, which has 2 items. Therefore, the summary score for general health is multiplied by 2 to keep the dimensions equivalent. The score for each domain can range from -12 to +12. No overall score is assigned.

We compared the psychological measures described above with objective clinical assessments. Therefore, the complexity of malocclusion was assessed for each subject with the Index of Complexity, Outcome, and Need (ICON).35 In this study, we evaluated both the overall occlusion and the esthetic component scores of malocclusion, which range on an interval scale from 7 to 120 and 1 to 10, respectively. The esthetic component of the ICON rates the attractiveness of the dentition. The higher the ICON score, the worse the malocclusion. According to the original authors, a total ICON score greater than 43 indicates need for orthodontic treatment; a posttreatment score of less than 31 signifies acceptable occlusion.35

An ICON score was calculated for each precomprehensive and postinterceptive patient from their pretreatment study models and, when applicable, posttreatment study models by 2 calibrated researchers (K.R.T. and C.J.J.). After independently assessing 181 study models, the researchers achieved excellent interexaminer reliability, with a concordance correlation coefficient of 0.97 (95% CI, 0.94-0.97). Intrarater reliability of the examiners was also reasonable, as determined by Dahlberg’s formula36 on 10 sets of models remeasured 2 weeks later (4.1 and 5.3). The final ICON scores (total and esthetic) were calculated by averaging the 2 examiners’ scores. When these ICON scores differed
by more than 9 points for a set of models, the examiners discussed the case and reached a consensus score (this occurred in 14 of 181 cases). Brown and Richmond recommended an acceptable interrater agreement of no more than ±18 points; thus, our criteria were more stringent.

Only the esthetic component of the ICON score was obtained for the comparison subjects. Since these patients had no study models, a frontal photo of each subject’s teeth was taken after they completed the questionnaire. They were categorized into 1 of 2 groups: those with an esthetic ICON score of less than or equal to 4, and those with an esthetic ICON score greater than 4. This cutoff point was used to determine orthodontic need based solely on dental esthetics (no need, ICON esthetic score ≤4, vs need, ICON esthetic score >4). For example, an adolescent scoring 5 on the esthetic component would have a minimum total ICON score of 35 (the esthetic score is multiplied by 7 to determine its overall value in the total ICON score), and, therefore, he or she would be close to qualifying for orthodontic need based solely on esthetics. Three examiners scored the photos (K.R.T., G.J.H., G.M.G.); a majority consensus was used to determine whether the subject would be above or below the esthetic ICON cutoff score of 4.

Approval was obtained from the Children’s Hospital and Regional Medical Center Institutional Review Board of Seattle, Wash. Only adolescents whose parents gave written consent and who signed an assent form were included in the study.

Participants took the questionnaires either before or after active orthodontic treatment, or, for the comparison group (nonorthodontic pediatric dental patients), immediately before a routine dental appointment. The study time commitment was approximately 20 minutes. Volunteers received a $5 gift certificate for their time.

Statistical analysis

Descriptive statistics were tabulated for each group of participants. The YQoL, COHQoL, and Treatment Expectation scores were skewed toward a positive QoL (skewness test, P < 0.05). Therefore, to provide a more conservative analysis, nonparametric statistical tests were used. The nonparametric Wilcoxon Mann-Whitney test was used to compare 2 samples. The Kruskal-Wallis test was used to compare 3 groups; for significant results in multiple group comparisons, post-hoc tests were used to examine pairwise differences. The nonparametric Spearman correlation test was used as an alternative to the Pearson product-moment correlations to evaluate associations between the different scales. The Wilcoxon signed rank test was used to analyze pretreatment to posttreatment changes. Because of the many correlations, we set the significance level at 0.01.

RESULTS

Table I gives the demographic and occlusion characteristics of this sample. Moderate and high ICON esthetic scores (>4) were compared with low ICON esthetic scores (≤4) in the comparison group (mean ICON esthetic score, 4.0 ± 1.9). This cutoff point represents a need for orthodontic treatment based solely on dental esthetics. There were no differences on any YQoL and COHQoL total or domain scores between adolescents whose ICON esthetic scores were ≤4 or >4, so all subjects in the 2 comparison samples could be analyzed in 1 group.

Research question 1 asked whether there was a difference between patients at the UW Orthodontic and Pediatric Dental Clinics and those receiving care at a community health clinic. In the precomprehensive group, we found no statistically significant differences in total YQoL or COHQoL, on the individual domain scores for either questionnaire, or in Treatment Expectations between the different orthodontic clinics. In the comparison groups, there were also no differences in total YQoL, total COHQoL, and individual domain scores for either questionnaire between the pediatric dental clinics. Because of these similarities in the QoL measures between the 2 sites, no further distinctions were made between the subgroups. The 2 subgroups of precomprehensive orthodontic patients in the 2 clinics were combined. Likewise, participants from both pediatric dental clinics were included in the comparison group.

Research question 2 asked whether there is an association between OHQoL and general QoL. Spearman correlation tests showed that YQoL total and domain scores were significantly correlated with each other in all 3 groups (P < 0.0001). Similarly, COHQoL total and domain scores were highly associated with each other (P < 0.001), although the correlation between the COHQoL emotional well-being domain and the COHQoL oral symptoms domain in the postinterceptive group only approached significance (P = 0.05). For the precomprehensive group, Treatment Expectation domains were also significantly intercorrelated (P < 0.001). For all groups, the association between YQoL and COHQoL followed a similar pattern, as shown in Figure 2.

Research question 3 asked whether there is a relationship between general QoL, OHQoL, Treatment Expectations, and malocclusion in the precomprehensive group. To address this question, we tested the correlation between YQoL, COHQoL, Treatment
Expectations, and ICON scores in the precomprehensive group. Treatment Expectations were significantly correlated with the COHQoL, but not with the YQoL (Table II). There were no significant associations between total and domain scores on the YQoL and components of the Treatment Expectations scale. On the other hand, 3 of the 4 expectation domains (social, appearance, and health) were correlated with the COHQoL total scores, and with the emotional well-being and social well-being domains. Similarly, the COHQoL oral-impact item, asking participants how much their oral condition affects life overall, was correlated with the social and appearance domains of treatment expectations. Expectations for improved oral function were not correlated with any QoL scores, and no expectation domain correlated with the COHQoL oral-health item related to the “health of the teeth, lips, jaw, or mouth.”

In the precomprehensive group, objectively assessed malocclusion as indicated by total and esthetic ICON scores was unrelated to either general or OHQoL. These scores were not correlated with total or domain scores on the YQoL or COHQoL, or with the COHQoL oral-impact item. However, the correlation between the COHQoL oral-health item and total ICON scores approached significance \( P < 0.05 \).

We also tested the relationship between postinterceptive ICON scores and the QoL measures. As with the precomprehensive group, the total and esthetic ICON scores were not correlated with YQoL and COHQoL in the postinterceptive group. For the comparison group, we compared children who were rated as having good to fair dental esthetics (ICON esthetics score \( \geq 4 \)) with those with poor dental esthetics (ICON esthetics score \( > 4 \)). There was no difference between these 2 subgroups on overall or OHQoL, indicating no association between the orthodontists’ judgment of the esthetics of malocclusion and the children’s self-reported general or OHQoL.

![Fig 2. Scatter plots of total YQoL vs total COHQoL for the 3 study groups.](image)

<table>
<thead>
<tr>
<th>Table II. Correlation between Treatment Expectations vs YQoL and COHQoL: precomprehensive treatment sample</th>
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<tbody>
<tr>
<td>Expectation</td>
</tr>
<tr>
<td>YQoL</td>
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The values are Spearman rho, with significance indicated by *\( P < 0.01 \); †\( P < 0.001 \).
We examined the associations in each study group. Table III summarizes the findings in response to research question 4: do YQoL and COHQoL scores differ between precomprehensive and postinterceptive adolescents, and do these groups differ from adolescents who are not seeking orthodontic treatment? To investigate these questions, we compared scores on YQoL and COHQoL instruments across all 3 groups. As Table III shows, no differences emerged between the precomprehensive, postinterceptive, and comparison groups in total YQoL or any of its domains. There were also no differences between the groups in total COHQoL or any of its domains. However, there was a statistically significant difference in the COHQoL global item regarding oral health; the postinterceptive group perceived their oral condition to be better than did the precomprehensive participants (\(P < 0.001\)). The comparison group’s average score on this item was between the precomprehensive and postinterceptive responses and did not differ significantly from either group.

Research question 5 asked: do preorthodontic treatment expectations differ from postinterceptive experiences among patients who have completed interceptive treatment? And do these changes and patient-reported experiences correlate with objectively assessed changes in occlusion? We tested changes in ICON scores and differences between treatment expectations vs experiences for patients in the postinterceptive group. As shown in Table I, adolescents who had completed interceptive orthodontic treatment had a significant improvement in both total ICON and the ICON esthetic component (\(P < 0.0001\)). Treatment Expectations did not differ significantly from Treatment Experiences (Fig 3). The participants experienced as much improvement from orthodontic treatment as they had expected.

In further responding to research question 5, we tested whether changes from expectations to experiences correlated with posttreatment ICON scores; additionally, we evaluated whether the treatment experiences responses alone correlated with posttreatment ICON scores. As Table IV shows, no significant correlations emerged between the pretreatment to posttreatment improvements in total ICON or the ICON esthetic component and the changes from treatment expectations to treatment experiences. This suggests that greater improvement in occlusion would not necessarily impact the patient’s perception of improvement from orthodontic treatment. This finding may also reflect the small change in scores between expectations and experiences compared with the large changes in ICON scores.

Furthermore, when analyzing the relationship between changes in total ICON and the ICON esthetic scores with responses to the Treatment Experiences

### Table III. Comparison of precomprehensive treatment vs postinterceptive treatment vs comparison groups on YQoL and COHQoL responses (mean ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Precomprehensive treatment</th>
<th>Postinterceptive treatment</th>
<th>Comparison</th>
<th>(P) value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YQoL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>82.59 ± 12.80</td>
<td>82.33 ± 12.71</td>
<td>82.18 ± 12.26</td>
<td>0.85</td>
</tr>
<tr>
<td>Sense of self</td>
<td>79.13 ± 14.83</td>
<td>77.02 ± 14.61</td>
<td>78.63 ± 14.86</td>
<td>0.45</td>
</tr>
<tr>
<td>Social relationships</td>
<td>83.16 ± 14.41</td>
<td>83.46 ± 14.84</td>
<td>83.91 ± 13.01</td>
<td>0.97</td>
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<tr>
<td>Environment</td>
<td>85.87 ± 12.55</td>
<td>86.08 ± 12.72</td>
<td>82.74 ± 12.76</td>
<td>0.19</td>
</tr>
<tr>
<td>General QoL</td>
<td>82.90 ± 16.46</td>
<td>84.97 ± 13.08</td>
<td>85.80 ± 13.66</td>
<td>0.52</td>
</tr>
<tr>
<td><strong>COHQoL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>18.08 ± 11.83</td>
<td>19.00 ± 12.73</td>
<td>17.97 ± 11.07</td>
<td>0.94</td>
</tr>
<tr>
<td>Oral symptoms</td>
<td>25.67 ± 12.58</td>
<td>30.02 ± 13.59</td>
<td>27.86 ± 13.27</td>
<td>0.13</td>
</tr>
<tr>
<td>Functional limitations</td>
<td>18.57 ± 12.05</td>
<td>19.38 ± 12.97</td>
<td>17.88 ± 12.88</td>
<td>0.54</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>18.43 ± 17.47</td>
<td>18.45 ± 20.57</td>
<td>18.57 ± 16.88</td>
<td>0.78</td>
</tr>
<tr>
<td>Social well-being</td>
<td>14.05 ± 14.08</td>
<td>14.07 ± 14.31</td>
<td>13.12 ± 12.17</td>
<td>0.91</td>
</tr>
<tr>
<td>Oral-health item</td>
<td>1.95 ± 0.82†</td>
<td>1.36 ± 0.84†</td>
<td>1.68 ± 0.90</td>
<td>0.001*</td>
</tr>
<tr>
<td>Oral-impact item</td>
<td>1.30 ± 1.09</td>
<td>1.53 ± 0.95</td>
<td>1.34 ± 1.08</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*\(P < 0.001\); †The Dunn test showed that the only significance was between the precomprehensive and postinterceptive groups (\(P < 0.001\)).
DISCUSSION

Adolescent dental patients aged 11 to 14 years generally report high QoL—both general and COHQoL. This was found even among children planning to have orthodontic treatment. This is consistent with previous studies on healthy adolescents by Jokovic et al., Topolski et al., and Locker et al.

A few previous studies found improvements in OH-QoL after orthodontic treatment. However, we found no differences in OHQoL or overall QoL between the 3 groups (precomprehensive, postinterceptive, and comparison). Whereas the responses were skewed toward a positive QoL, the standard deviations were large in all 3 groups. This might indicate that QoL is determined by factors other than malocclusion status. Therefore, the impact of malocclusion and orthodontic intervention on general QoL and COHQoL might be individually determined.

Although the YQoL and COHQoL responses did not differ between the groups, the precomprehensive participants believed that orthodontic treatment would be of value and improve aspects of their lives as reported in the Treatment Expectations questionnaire. Results from the postinterceptive sample suggested that patients were not disappointed; they achieved improvements in their lives from orthodontic treatment just as they had expected. The patients reported, after active orthodontic treatment, that they experienced improvements in oral function, appearance, health, and social well-being. They were satisfied with the improvements, but this was not reflected in the other QoL measures.

Our results illustrate that objectively assessed malocclusion severity has little effect on patients’ perceptions of their general and COHQoL. Even for those whose malocclusion affected their dental esthetics in the nonorthodontic comparison group (scores >4), neither overall nor OHQoL was impaired. These children did not differ from their counterparts with more attractive occlusions in how they rated the health of their teeth, lips, jaws, and mouths. These results differed from previous studies that found a distinct OHQoL gradient with varying severities of malocclusion.

We also evaluated the participants according to the ICON’s Need and Outcome guidelines. In comparing precomprehensive participants, we found that those needing orthodontic care (ICON >43) had similar general and OHQoL scores as those who were determined to have no orthodontic need (ICON <43). In the postinterceptive group, there was also no significant difference between those who had a successful occlusal outcome after orthodontic treatment (ICON <31) vs those who still had orthodontic needs after interceptive care (ICON >43). Therefore, neither the postinterceptive group nor the precomprehensive group supported the idea that the complexity of the malocclusion influences COHQoL.

Furthermore, our results suggest that there is no association between improved occlusion as judged by orthodontists after treatment and patients’ perceived improvements in their oral function, appearance, social lives, or health. This does not mean, however, that these areas of well-being did not improve with orthodontic treatment. Postinterceptive participants reported as much improvement as they had expected, but this was independent of the occlusal improvement assessed by orthodontists. This might also be attributable to the generally high scores on the Treatment Experience questionnaire, with relatively low variance.

It is encouraging that the postinterceptive participants rated their oral health significantly better than did the precomprehensive participants (P <0.001). The comparison participants scored between the precomprehensive and postinterceptive groups in self-reported oral health. Although the COHQoL measure does not ask whether malocclusion affects the child’s QoL and simply asks about the impact of current oral health, it appears that adolescents who have had orthodontic treatment respond from the perspective of satisfied patients. However, this did not generalize to overall and COHQoL total or domain scores. This might be because the 2 scales are not sensitive to the impact of such changes or that improved occlusion simply does not affect other aspects of one’s life.
An additional explanation of our findings could be what psychologists call a “hedonic treadmill.” Many believe that well-being has a fixed set point for each person that cannot easily be changed. And because orthodontic treatment takes place over several years, a patient has time to adjust and return to his or her set point. Therefore, we should not expect to see a change in psychological measures after orthodontic treatment. Diener et al. stated that “good and bad events temporarily affect happiness, but people quickly adapt back…. individual and societal efforts to increase happiness are doomed to failure.” Patients might have forgotten their initial condition and cannot evaluate their progress, or they might have already adapted to the final occlusal and esthetic outcome and, thus, there is no impact on QoL. Therefore, our findings do not necessarily reflect poorly on orthodontics but are consistent with general human behavior.

It is also noteworthy that adolescents in the university and community health clinics did not differ on the QoL measures. They did not even differ on the YQoL environment domain, suggesting its lack of sensitivity for the healthy adolescent dental population. Additionally, there were no differences in expectations between those planning orthodontic treatment at the 2 clinics. This finding also suggests that QoL is influenced more by personality than by socioeconomic and environmental factors.

This study had some limitations. Most notably, except for some measures for the postinterceptive sample, this was a cross-sectional study. Although it would be ideal to follow these participants prospectively from pretreatment to posttreatment, and to compare them with those who did not seek treatment, we thought it was important to limit participants’ age range to 11 to 14 years to minimize maturity and developmental influences on QoL. QoL is a complex construct that depends on psychological development and maturity level, so having a small age range or following the same group prospectively is preferred. We were also limited by the clinical outcomes of our postinterceptive group. The average posttreatment total ICON score was 48.9 ± 21.4; this is higher than the 31-point cutoff that indicates successful treatment according to ICON criteria. In addition, the comparison group had slightly better ICON esthetics than the postinterceptive group’s post-treatment ICON esthetic scores (4.0 vs 4.6, respectively). This might affect conclusions regarding the impact of interceptive treatment vs no treatment. Inherent in interceptive treatment is that there is still room for occlusal and esthetic improvement. Nevertheless, even with this objectively less than ideal improvement, postinterceptive patients have high COHQoL and overall QoL scores. In addition, as discussed previously, the available QoL measures might not be sensitive enough to measure the impact of improved malocclusion or to distinguish this from the impact of oral diseases and psychological factors on well-being.

CONCLUSIONS

1. In general, 11-to-14 year-old adolescents have high overall and COHQoL scores.
2. There was no difference in general QoL or COHQoL between precomprehensive orthodontic patients, postinterceptive orthodontic patients, and the comparison group of adolescents who were not seeking treatment.
3. General QoL and COHQoL scores had a similar pattern of correlation for the 3 groups.
4. Malocclusion and its treatment have little effect on general QoL or COHQoL, but improved occlusion does improve adolescents’ self-ratings of oral health.
5. Posttreatment assessment of occlusion showed significant improvement, but, regardless of the extent of objective change, adolescents reported as much improvement in 4 areas of their lives (oral function, appearance, social function, and health) as they had expected.

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REFERENCES