Changes in oral health-related quality of life reports in children during orthodontic treatment and the possible role of self-esteem: a follow-up study

Veronique Brosens*,†, Ines Ghijselings*,†, Jurgen Lemiere**, Steffen Fieuws***, Maïté Clijmans * and Guy Willems*

*Department of Oral Health Sciences–Orthodontics, Katholieke Universiteit Leuven & Dentistry, University Hospitals Leuven, **Child and Adolescent Psychiatry/Pediatric Haemato-Oncology, Universitair Ziekenhuis Gasthuisberg, ***Interuniversity Institute for Biostatistics and Statistical Bioinformatics, Katholieke Universiteit Leuven, Universiteit Hasselt, Belgium

'These authors contributed equally to this work.

Correspondence to: Guy Willems, Department of Oral Health Sciences–Orthodontics, Katholieke Universiteit Leuven, Kapucijnenvoer 7, Leuven B-3000, Belgium. E-mail: guy.willems@med.kuleuven.be

SUMMARY
OBJECTIVES: As a continuation of a baseline study on oral health-related quality of life (OHRQoL) and the role of self-esteem (SE), the aim of this research is to investigate the changes in OHRQoL reports in children during orthodontic treatment and the influence of SE.

SUBJECTS AND METHODS: This longitudinal study comprised 109 children (50 boys and 59 girls) aged 11–16 years, all receiving orthodontic treatment. Questionnaires were administered at baseline and at follow-up (1 year after start of orthodontic treatment). OHRQoL was assessed by the child perception questionnaire (CPQ). The Dutch adaptation of the Harter’s Self-Perception Profile for Adolescents was used to assess SE and the Index of Orthodontic Treatment Need defined the need for treatment. The questionnaires also included questions related to motivation for treatment. Spearman correlations, Wilcoxon signed rank tests and Mann–Whitney U-tests were performed.

RESULTS: A significant increase in total CPQ score was found during orthodontic treatment. This increase was also significant for the subdomains functional limitations, oral symptoms, and social well-being, whereas for the subdomain emotional well-being a non-significant decrease in CPQ score was found. Children with high SE at baseline showed significantly lower variability in OHRQoL measures at follow-up.

CONCLUSIONS: OHRQoL deteriorates in children during orthodontic treatment. There is evidence that SE can be a protective factor in OHRQoL during orthodontic treatment.

Introduction

A malocclusion is rarely a life-threatening disease, but it does affect physical, social, and psychological functioning, which can be defined as ‘quality of life’. Quality of life can be determined as ‘a person’s sense of well-being, that stems from satisfaction or dissatisfaction with the areas of life that are important to him or her’ (Cunningham and Hunt, 2001). One of the reasons for undertaking orthodontic treatment is the improvement in aesthetics and subsequent improvement of psychosocial well-being. (Shaw, 1981; Shaw et al., 1985; DiBiase and Sandler, 2001; Trulsson et al., 2002). Many indices have been developed in order to objectify malocclusion and treatment need. For example, the Index of Orthodontic Treatment Need (IOTN) according to Brook and Shaw is widely used because of its practical and efficient application (Brook and Shaw, 1989; Jones et al., 1996; Younis et al., 1997). However, these indices do not give any information about the impact of malocclusion on the quality of life, and the psychological well-being of the patients is often ignored.

The interest in oral health-related quality of life (OHRQoL) has increased considerably in the past decade. The child perception questionnaire (CPQ), which measures the OHRQoL in children, has already been validated in orthodontic research (Jokovic et al., 2002; O’Brien et al., 2006). In addition, several recently performed studies investigated more psychological aspects, such as self-esteem (SE), of orthodontic treatment (Agou et al., 2011). SE can be defined as the perception of one’s own ability to master or deal effectively with the environment and is affected by the reactions of others towards an individual (Tung and Kiyak, 1998).

Several studies investigated on the effect of orthodontic treatment on OHRQoL between treated patients and an untreated control group (Birkeland et al., 2000; Kiyak 2008; Agou et al., 2011), but it is also of particular importance to report on the changes in OHRQoL during orthodontic treatment (Stewart et al., 1997; Zhang et al., 2008; Chen et al., 2011).
Understanding the impact of orthodontic treatment on quality of life is of great importance for many reasons. Informing the patients about the consequences and discomfort can lead to a better understanding. Informed consent gives the patients insight into the benefits and health gains associated with orthodontic treatment, which might help overcome problems associated with non-compliance (Sergl et al., 1998).

A recent cross-sectional study at baseline was performed to investigate whether a relationship exists between orthodontic treatment need and OHRQoL and whether this relationship is influenced by SE (De Baets et al., 2012). They found that (1) the higher the SE, the better the OHRQoL, (2) the OHRQoL (for some domains and for the total CPQ score) is better if treatment need is lower, and (3) there is no evidence that SE moderates the relationship between OHRQoL and treatment need.

To continue this investigation the cross-sectional study was extended to a longitudinal level. The first aim of the present study is to describe the changes of OHRQoL during orthodontic treatment 1 year after the start of treatment. What is the impact of orthodontic treatment based on changes in IOTN and OHRQoL after 1 year of treatment? And could SE be a protective factor? The hypothesis is that (1) OHRQoL will deteriorate during treatment, while treatment need will decline and (2) that children with high SE at baseline will have fewer changes in OHRQoL during treatment.

Subjects and methods

Since the baseline study (De Baets et al., 2012), the intake of patients between 11 and 16 years old, who are registered for a first consultation at the Orthodontic Department of the University Hospitals of Leuven (Belgium), has continued. As described in our baseline article (De Baets et al., 2012) the patients and one of their parents are requested to complete a questionnaire before clinical examination. The following inclusion and exclusion criteria were handled: a minimum age of 11 and a maximum age of 16 were necessary to be included as well as the absence of previous orthodontic treatment. A thorough knowledge of the Dutch language for both children and parents was required to understand the questionnaires. Severe medical problems, both physical and mental, were a reason to be excluded from the study.

The study protocol was approved by the Medical Ethics Committee of the University Hospitals of Leuven (Belgian Number B3220096365, 8 May 2009). Informed consent was obtained for all subjects and one of their parents. The OHRQoL of the child was scored by the use of the Dutch translation of the CPQ (Jokovic et al., 2002; O’Brien et al., 2006). The CPQ contains 37 questions about the frequency of events in four domains: oral symptoms (OS), functional limitations (FL), emotional well-being (EW), and social well-being (SW). Each item asks about the frequency of events, as applied to the teeth, lips and jaws, in the last 3 months. Each question has five possible answers: ‘never’ (scoring 0), ‘once or twice’ (1), ‘sometimes’ (2), ‘often’ (3), and ‘every day or almost every day’ (4). Besides a total CPQ score, each domain can be rated separately. Note that higher CPQ scores refer to worse OHRQoL. Further, SE was assessed by the Dutch adaptation of the Harter’s Self-Perception Profile for Adolescents (SPPA) (Harter, 1988; Treffers et al., 2002). This questionnaire consists of 35 questions designed to discover the adolescent’s perception of themselves in different domains: social skills, social acceptance, sports skills, physical appearance, behavioural manner, close friendship, and sense of dignity (SD). In line with our baseline study, SD was considered as a measure of global SE (Hagborg, 1993). The raw scores were converted into percentile scores by using the age norms of the Dutch adaptation of the SPPA (Treffers et al., 2002). Further, treatment need was determined by recording the IOTN during clinical examination. Both dental health component (DHC) and aesthetic component (AC) were recorded. An IOTN–DHC score of 3 or greater and an IOTN–AC score of at least 5 were considered as clinical need for treatment (Kuijpers and Kiekens, 2005). Additionally, two extra questions regarding motivation for an orthodontic treatment were added. The first question asks about the child’s own motivation for an orthodontic treatment and the second questions asks about how much the child will be encouraged by others to wear an orthodontic appliance. These questions were recorded on a seven point Likert scale. The study group at baseline consisted of 223 patients (113 boys and 110 girls) with a mean age of 13.22 years (SD 1.35) (De Baets et al., 2012). Eighty-five patients (48 boys and 37 girls) did not start orthodontic treatment; this resulted in a longitudinal study group of 138 patients (65 boys and 73 girls) (Figure 1). This group was monitored during their orthodontic treatment. One year after start, the patients and parents were asked to complete the same questionnaires again. Concurrently, the orthodontist assessed the IOTN and registered the stage of treatment. Twenty-nine patients of this study group of 138 subjects dropped out because of various reasons: in 16 patients treatment was stopped because of non-compliance, for three patients treatment was stopped because of medical problems, two patients had a treatment time shorter than 1 year and for another eight patients, the patient or parents did not complete the questionnaires. This resulted in a final study group of 109 patients (50 boys and 59 girls) with required follow-up information (Figure 1). Besides this final study group (n = 109), the group without follow-up information consisted of 114 patients (85 patients who did not start treatment and 29 patients who truly dropped out).

Statistical analysis

All analyses have been performed using SAS software, version 9.2 of the SAS System for Windows © 2002 SAS Institute Inc.
SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, North Carolina, USA. Spearman correlations are used to evaluate the relation between continuous/ordinal variables. Mann–Whitney U-tests and Fisher’s exact tests were used for comparisons between two groups. Changes in measurements over time are analysed with a Wilcoxon signed rank test. No corrections for multiple testing were used. As a result, a single \( P \)-value needs to be interpreted with care.

**Results**

**Data description**

Follow-up data were successfully obtained from 109 patients 1 year after start of their orthodontic treatment, besides the 114 patients without follow-up information. The latter group has to be separated into two major parts: 85 patients did not start an orthodontic treatment at our department, whereas 29 patients did start an orthodontic treatment but dropped out during follow-up. When looked for differences between patients who started an orthodontic treatment \((n = 138)\) and who did not start an orthodontic treatment \((n = 85)\), no significant differences were found regarding age, gender, educational level, OHRQoL, and SE. Patients who started treatment scored significantly \((P < 0.05)\) higher on motivational questions. Further, when looked for differences between our study group \((n = 109)\) and the dropout group \((n = 29)\), there is a significant difference \((P < 0.05)\) regarding their education level. The dropout group comprised a higher percentage of patients who are in a lower level of education type. Further there is no indication of any difference between the study group and the dropout group with respect to age, gender, motivation, OHRQoL and SE.

**Evolution of treatment need**

The AC as well as the DHC decreases significantly \((P < 0.0001)\) during treatment (Table 1). For AC, the percentage of patients with moderate/severe need decreases from 42.2 per cent to 9.2 per cent. For DHC, the percentage of patients with moderate/severe need decreases from 89.0 per cent to 46.8 per cent.

**Evolution of OHRQoL**

There is a significant \((P < 0.0001)\) increase in the total CPQ score during treatment. When the scores of the subdomains were taken into consideration, this increase is significant \((P < 0.0001)\) for three domains (OS, FL and SW), but for the EW domain a non-significant \((P = 0.3352)\) decrease was measured (Table 2).

**Relation of SE with change in OHRQoL**

Patients with a higher baseline SE show significantly \((P = 0.0066)\) lower variability in their overall OHRQoL 1 year after start of their orthodontic treatment (Figure 2). This correlation, however, is weak \((\rho = -0.26)\). When looked for each subdomain separately, a significant correlation is found between SE and absolute change in FL \((P = 0.0378)\), EW \((P = 0.0225)\) and SW \((P = 0.0043)\). For OS a non-significant \((P = 0.1046)\) correlation was found.

**Discussion**

Improvement in OHRQoL is nowadays one of the most important factors of an orthodontic treatment. Many OHRQoL measures have been used in a cross-sectional study design, as

---

**Table 1** Evolution of treatment need (Index of Orthodontic Treatment Need). Differences in dental health component (DHC) and aesthetic component (AC) between baseline and 1 year after start of orthodontic treatment. SD, standard deviation; Min, lowest value; Max, highest value; \( P \)-value from Wilcoxon signed rank test \(n = 109\).

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>Mean</th>
<th>SD</th>
<th>Med</th>
<th>Min</th>
<th>Max</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC baseline</td>
<td>109</td>
<td>4.57</td>
<td>2.09</td>
<td>4.00</td>
<td>1.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>AC 1 year</td>
<td>109</td>
<td>2.74</td>
<td>1.29</td>
<td>2.00</td>
<td>1.00</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>109</td>
<td>-1.83</td>
<td>2.01</td>
<td>-1.00</td>
<td>-8.00</td>
<td>2.00</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>DHC baseline</td>
<td>109</td>
<td>3.59</td>
<td>0.86</td>
<td>4.00</td>
<td>2.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>DHC 1 year</td>
<td>109</td>
<td>2.66</td>
<td>0.86</td>
<td>2.00</td>
<td>1.00</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>109</td>
<td>-0.93</td>
<td>0.94</td>
<td>-1.00</td>
<td>-3.00</td>
<td>1.00</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

*Correlation significant \((P < 0.05)\).
Changes in oral health-related quality of life reports in children during orthodontic treatment

As expected, treatment need decreased significantly 1 year after start of an orthodontic treatment, but of more interest was the evolution of OHRQoL 1 year after start of orthodontic treatment. In our previous study we hypothesized that OHRQoL will improve especially because of the results of orthodontic treatment. Nevertheless, the present study was carried out during treatment and therefore we expect the OHRQoL to worsen (De Baets et al., 2012). Indeed, a significant deterioration of overall OHRQoL was noted during treatment compared with pre-treatment. At the level of each domain separately, a significant decrease was evident for the objective dimensions, addressing OS and FL. For the higher order disability measures (SW and EW), a decrease was also found for SW, but an increase was measured for the EW domain. A study of Zhang et al. (2008) confirms these findings. Subjects experienced OS (deterioration) but particularly more FL compared with pre-treatment. A possible explanation is

Table 2 Evolution of oral health-related quality of life (OHRQoL; total scores and domain scores for the child perception questionnaire [CPQ11–14] at baseline and 1 year after start of orthodontic treatment). SD, standard deviation; Min, lowest value; Max, highest value; \( P \)-value from Wilcoxon signed rank test \( n = 109 \).

<table>
<thead>
<tr>
<th>OHRQoL (CPQ)</th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (baseline)</td>
<td>17.01</td>
<td>10.41</td>
<td>15.00</td>
<td>1.00</td>
<td>66.00</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Total (1 year)</td>
<td>21.69</td>
<td>10.57</td>
<td>20.00</td>
<td>3.00</td>
<td>63.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>4.68</td>
<td>11.73</td>
<td>5.00</td>
<td>−57.0</td>
<td>34.00</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>Oral Symptoms (baseline)</td>
<td>6.26</td>
<td>3.00</td>
<td>6.00</td>
<td>0.00</td>
<td>14.00</td>
<td></td>
</tr>
<tr>
<td>Oral Symptoms (1 year)</td>
<td>7.80</td>
<td>2.94</td>
<td>7.00</td>
<td>0.00</td>
<td>14.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1.54</td>
<td>3.72</td>
<td>2.00</td>
<td>−8.00</td>
<td>9.00</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Functional limitations (baseline)</td>
<td>4.02</td>
<td>3.00</td>
<td>4.00</td>
<td>0.00</td>
<td>15.00</td>
<td></td>
</tr>
<tr>
<td>Functional limitations (1 year)</td>
<td>6.48</td>
<td>4.31</td>
<td>6.00</td>
<td>0.00</td>
<td>19.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>2.46</td>
<td>4.19</td>
<td>2.00</td>
<td>−6.00</td>
<td>16.00</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Social well-being (baseline)</td>
<td>2.52</td>
<td>3.04</td>
<td>1.00</td>
<td>0.00</td>
<td>18.00</td>
<td></td>
</tr>
<tr>
<td>Social well-being (1 year)</td>
<td>3.83</td>
<td>2.99</td>
<td>3.00</td>
<td>0.00</td>
<td>19.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>1.31</td>
<td>3.51</td>
<td>1.00</td>
<td>−18.0</td>
<td>15.00</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Emotional well-being (baseline)</td>
<td>4.21</td>
<td>5.24</td>
<td>3.00</td>
<td>0.00</td>
<td>30.00</td>
<td></td>
</tr>
<tr>
<td>Emotional well-being (1 year)</td>
<td>3.58</td>
<td>4.23</td>
<td>2.00</td>
<td>0.00</td>
<td>21.00</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>−0.63</td>
<td>5.26</td>
<td>0.00</td>
<td>−29.0</td>
<td>18.00</td>
<td>0.3352</td>
</tr>
</tbody>
</table>

*Change significant (\( P < 0.05 \)).

Figure 2 Relation of self-esteem with absolute change in oral health-related quality of life [total child perception questionnaire (CPQ) score].
that these disability measures change because they involve an interaction with another individual. Actually, the patients report that their interactions with other people are affected, which is similar to the literature concerning social judgments (Jeremiah et al., 2011). Our findings could be explained by two possibilities. First, children were asked to complete the questionnaires immediately after their monthly activation, which causes some pain and discomfort. Second, all patients were treated with the standard edgewise system, in which multiloop stainless steel archwires were used. They are less aesthetic and could produce more discomfort. The literature of pain and discomfort in orthodontics is confusing. There are studies that report higher rates of pain experience during engagement of the archwire in self-ligating systems (Fleming et al., 2009; Tecco et al., 2009; Bertl et al., 2013), while other studies report no difference between self-ligating and conventional systems (Scott et al., 2008). Further, adaptation to continuous pain and discomfort with the progression of treatment is also reported (Sergl et al., 1998; Sergl et al., 2000). They report an adaptation to new appliances within the first 7 days after appliance insertion (Sergl et al., 2000). The majority of our study group, however, received their second appliance (mostly fixed appliances) during the period studied; which might influence their experience regarding the intensity of complaints and the amount of discomfort. This might have influenced their answers while completing the questionnaires.

Subjects’ SW also decreased, but less than their objective dimensions. The apparent paradox of the EW domain might be related to the fact that fixed appliances are becoming more and more popular and that the subjects’ peers are more accustomed to fixed appliances so that psychological adaptation occurs more rapidly (Zhang et al., 2008).

Further, our results show a significant correlation between SE and the absolute changes in OHRQoL: the higher the SE at baseline, the lower the variability in OHRQoL during treatment. These results are confirmed by a previous study of Agou et al. (2011). However, when each domain is analysed separately, no significant correlation is found between SE and the variability in OS. Agou and co-workers (2011) confirm these findings. They stated that the contribution of psychological well-being to the variance in OHRQoL was considerably greater for the SW and EW domains compared with the OS and FL subscales (Agou et al., 2011). As mentioned before prediction of patient’s compliance would create the possibility of reducing the level of orthodontic treatment discontinuation. It is, therefore, also important to evaluate the motivation of patients and their parents for orthodontic treatment. Discontinuation rates have been reported to be between 12 and 20 per cent (Haynes, 1982; Murray, 1989) and increase to around 40 per cent in 15- to 17-year old children (Haynes, 1991). In this study, we observed a dropout group of 29 patients. These subjects did not show any difference with the study group regarding gender, age, OHRQoL, motivation and SE. These results are in line with the findings of Mandall et al. (2008), where no effect was found for these factors to predict completion of treatment. Only the level of education was significantly different: subjects who dropped out had a lower education level. This indicates the importance of social and economic characteristics on an orthodontic treatment (Germa et al., 2010).

Our study design had limitations compared with a randomized controlled trial or case-control prospective study, but because of the questionable ethical approach, randomizing and not treating children with malocclusion was not done.

The OHRQoL measure used in this study is the CPQ11–14. Because of its demonstrable psychometric properties, the CPQ11–14 is a useful measure for orthodontic trials and has become a popular tool in orthodontic outcome research (Foster Page et al., 2005; Locker et al., 2005; O’Brien et al., 2006). The use of this instrument is validated for the age group 11–14 years, but in our study, we also included 15- to 16-year-old subjects. Furthermore, some authors question whether the CPQ is a good measure of OHRQoL in children with malocclusions (Locker et al., 2005; Marshman et al., 2010). Anyway, some criticism of subjective measures such as OHRQoL has to be taken into account: people may adapt or habituate to their (health) conditions over time and they may respond with lower impact scores when a questionnaire is re-administered at a later time (Rapley, 2003). In addition, despite our recall efforts, eight patients did not complete the questionnaire.

Finally, unlike other studies, the appliance type was not controlled for (Zhang et al., 2008; Chen et al., 2010; Kadkhoda et al., 2011). This was due to the variations in our study group. All kind of appliances were used because of the wide range of malocclusions. This made it very difficult to extrapolate well-defined groups of appliance type. However, fixed or functional appliances have been previously reported to produce a higher intensity of discomfort than removable appliances (Scheuer et al., 1996; Stewart et al., 1997; Sergl et al., 1998; Sergl et al., 2000). Kadkhoda et al. (2011) report no significant difference on OHRQoL measures in subjects wearing functional appliance or headgear. Bernabé et al. (2008) found a different pattern of sociodental impact by type of appliance. This difference was only obvious for the prevalence but not for the intensity or extent of condition-specific impact. Subjects wearing fixed appliances had a higher frequency of impact than those wearing removable or both types of appliance (Bernabé et al., 2008).

Conclusion

OHRQoL parameters deteriorate significantly during orthodontic treatment, except for the EW domain. Subjects with high SE at baseline had significantly lower variability in their OHRQoL measures. Therefore, SE could be a protective factor for OHRQoL during orthodontic treatment.
References


Locker D, Jokovic A, Tompson B 2005 Health-related quality of life of children aged 11 to 14 years with orofacial conditions. The Cleft palatocraniofacial journal: official publication of the American Cleft Palate-Craniofacial Association 42: 260–266


Rapley M 2003 Quality of Life Research. Sage, London


