

Effect of malocclusion or orthodontic treatment on oral health-related quality of life in adults

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Objective: The purpose of this study was to evaluate the effect of malocclusion or orthodontic treatment on oral health-related quality of life (OHRQoL) in adults. **Methods:** The sample consisted of 860 adults (378 men and 482 women, aged 18–39 years) who were clinically evaluated for malocclusion or orthodontic treatment experience. Participants were divided into 4 groups as follows: normal occlusion, malocclusion, fixed treatment, and retention. OHRQoL was assessed with the short form of the Oral Health Impact Profile (OHIP-14) and Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ). **Results:** The malocclusion group and the fixed treatment group had significantly higher OHIP-14 scores than the normal occlusion group and the retention group ($p < 0.001$). The malocclusion group had the highest PIDAQ score, while the normal occlusion group and the retention group had the lowest PIDAQ score ($p < 0.001$). Women had higher OHIP-14 and PIDAQ scores than men. A significant positive correlation was found between OHIP-14 and PIDAQ scores ($p < 0.01$). **Conclusions:** Malocclusion has a negative impact on OHRQoL, but this could be improved in adults through orthodontic treatment. These OHRQoL questionnaires can provide additional useful information on specific aspects of orthodontic patients' psychological state.
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INTRODUCTION

The benefits of orthodontic treatment include improved oral health and enhanced psychosocial well-being.¹ Although the principal goal of orthodontic treatment is still the restoration of oral health and function, the importance of esthetics and psychological impact is increasing. After orthodontic therapy, patients reported better body image and self-confidence related to appearance.^{2,3} These findings are supported by study results reporting that orthodontic treatment increases self-esteem and reduces anxiety in social relationships.^{4,5}

Although the psychosocial effects of orthodontic treatment are important, they have not yet been clearly defined.⁶ Research on the psychosocial effects of malocclusion and orthodontic treatment frequently conflicts due to differences in research design, population surveys, and study methods. This may be because orthodontic treatment is different from most other medical interventions; it does not cure or treat a condition, but rather aims to correct variations from an arbitrary norm.⁷

Clinical studies evaluating the need for or outcome of orthodontic treatments are usually conducted through the assessment of malocclusion models and the measurement of cephalometric radiographs. However, these evaluations are mostly based on the orthodontist's point of view, rather than that of the patient;⁸ orthodontists and patients may have different perceptions of the need for orthodontic treatment, the assessment of dental or facial esthetics, and the level of satisfaction with orthodontic treatment.⁹ Patient perceptions are important indicators of treatment needs and may complement conventional clinical measurement;¹⁰ they should therefore be considered.

As the importance of patient-centered outcome measure is increasing, the World Health Organization has recommended the inclusion of quality of life measurements in clinical studies.¹¹ Such research on quality of life is connected with the fact that the concept of health throughout all fields of medicine strives for not only the absence of disease, but also emotional well-being. In recent years, attention to patient-centered assessment has greatly increased in dental research.¹² Oral health-related quality of life (OHRQoL) has been defined as "the absence of negative impacts of oral conditions on social life and positive sense of dentofacial self-confidence".¹³ Thus, the orthodontist's point of view must also be expanded from dentofacial esthetics to the patient's overall OHRQoL. It shifts clinicians' and researchers' focus from the oral cavity alone to the patient as a whole.¹³ It is for these reasons that self-reported OHRQoL instruments should be used in orthodontics, as they allow the measurement of the

patient's own views and feelings.¹²

Recent studies using OHRQoL questionnaires have found that malocclusion is associated with low OHRQoL,¹⁴⁻¹⁶ but other studies that suggest the positive effects of orthodontic treatment on OHRQoL continue to be inconclusive.^{6,17-19}

Therefore, the aim of this study was to assess the effect of malocclusion or orthodontic treatment on OHRQoL in adults using two self-reported questionnaire instruments, compare the influence of gender, and evaluate possible correlations between instruments.

MATERIALS AND METHODS

The participants in this cross-sectional study were adults aged 18-39 years recruited from the orthodontic department at three Wonkwang University dental hospitals and six private dental clinics in Korea. A total of 952 people participated in the study; data from 860 were included in the final analysis. The exclusion criteria were (1) craniofacial anomalies such as a cleft lip or palate, (2) severe skeletal discrepancies requiring orthognathic surgery, (3) missing teeth or implants other than those extracted for orthodontic purposes, (4) undergoing adjunctive or removable orthodontic treatment, and (5) untreated dental caries or advanced periodontal disease. These criteria were established to prevent possible confounding effects of these conditions on participants' OHRQoL. Participants were informed of the study purpose and procedures according to medical article ethics guidelines, and were assured of the confidentiality of the information collected. Only those who gave informed consent were included in the study.

To assess the effect of malocclusion or orthodontic treatment on OHRQoL, participants were divided into four groups as follows: normal occlusion, malocclusion, fixed treatment, and retention.

The classification of the normal occlusion and malocclusion groups was decided clinically for adults who were visiting the dental clinics and who had not received previous orthodontic treatment. Classification was based on the alignment of anterior teeth and the degree of lip protrusion, as these aspects have the greatest influence on appearance. The clinical classification decisions were made by orthodontists who had studied the assessment criteria. Participants who were difficult to classify according to these criteria were excluded from the study.

The alignment of anterior teeth was assessed for crowding, spacing, and overjet. A participant was placed in the malocclusion group if he/she had crowding > 4 mm or spacing > 2 mm of the anterior teeth of both the maxilla and mandible. Participants with negative anterior overjets were also placed in the malocclusion group. The sum of the protrusion of the upper and

lower lip from the Ricketts esthetic line (E-line) was used for assessment. When the sum of upper and lower lip protrusion exceeded 4 mm, participants were placed in the malocclusion group. The normal occlusion group consisted of participants with anterior crowding < 3 mm, spacing < 1 mm, lip protrusion < 1 mm (E-line), Angle's Class I molar relationship, and a good profile.²⁰ The fixed treatment group included patients who were undergoing comprehensive orthodontic treatment using labial fixed orthodontic appliances, regardless of bracket type. The retention group included patients who had completed treatment using labial fixed orthodontic appliances within the past year and were currently wearing a retainer.

Questionnaire design

Short form of the Oral Health Impact Profile (OHIP-14)

The Korean version of the OHIP-14²¹ was used to measure the impact of oral problems on OHRQoL in the last 6 months. The questions assessed how frequently patients had experienced functional limitation, physical pain, psychological disability, social disability, and handicap.

This questionnaire has 7 domains. Each of the 7 domains contains 2 items, giving a total of 14 questions. Each question is scored on a 5-point Likert scale where 4 indicates very often (nearly every day); 3, fairly often (once or more per week); 2, occasionally (2–3 times per month); 1, hardly ever (once per month or less); and 0, never. Since it has been reported that OHIP scores weighted by questions are similar to unweighted OHIP scores in assessing OHRQoL,²² the sum of all OHIP question values were used as the OHIP-14 score. OHIP-14 score ranged from 0 to 56, with higher scores indicating lower OHRQoL.

Psychosocial Impact of Dental Aesthetics Questionnaire (PIDAQ)

The PIDAQ is a psychometric instrument used to assess orthodontic-specific aspects of quality of life. The PIDAQ has been tested for its validity, reliability, and factorial stability.²³ It is composed of 23 questions

across 4 domains: dental self-confidence (6 items), social impact (8 items), psychological impact (6 items), and esthetic concern (3 items).

Each question is scored on a 5-point Likert scale (4 indicates very strongly; 3, strongly; 2, somewhat; 1, a little; and 0, not at all). PIDAQ score was obtained by summing all question scores. Dental self-confidence is a positive domain while the other 3 are negative domains; thus, the positive domain was reverse-scored. PIDAQ score ranged from 0 to 92, with higher scores indicating a greater degree of negative psychosocial impact related to dental esthetics.

Statistical analysis

Statistical analysis was performed with SPSS for Windows (ver. 15.0; SPSS Inc., Chicago, IL, USA). Additive scale and subscale scores for the OHIP-14 and PIDAQ were calculated by summing the item response codes. A one-way analysis of variance (ANOVA) with least significant difference *post-hoc* test (LSD) was conducted to assess OHIP-14 and PIDAQ scores across groups. A paired *t*-test was performed to observe intra-group differences according to gender, and ANOVA with LSD was completed to verify gender differences by group. The interrelation between OHIP-14 and PIDAQ scores was analyzed using Pearson's correlation analysis.

RESULTS

Among the 952 people who completed the questionnaires, 860 adults (90.34%) met the inclusion criteria for the present study. The final sample used for analysis was composed of 378 men and 482 women. The average age of the study participants was 25.92 ± 5.30 years; subjects in their twenties accounted for two-thirds of the total group (Table 1). Reliability analysis showed that internal consistency was acceptable: Cronbach's alpha was 0.95 for the PIDAQ and 0.79 for the OHIP-14.

OHIP-14 scores differed significantly among groups (*p* < 0.001). *Post-hoc* analysis revealed that the malocclusion and fixed treatment groups had higher OHIP-14 scores than the normal occlusion and retention groups. These results show that the normal occlusion

Table 1. Distribution of participants by groups according to malocclusion or orthodontic treatment

	Participant	Male	Female	Age (yr)
Group 1 (normal occlusion)	208	103 (49.52)	105 (50.48)	27.31 ± 5.59
Group 2 (malocclusion)	202	93 (46.04)	109 (53.96)	26.55 ± 5.56
Group 3 (fixed treatment)	241	96 (39.83)	145 (60.17)	24.48 ± 4.91
Group 4 (retention)	209	86 (41.15)	123 (58.85)	25.59 ± 4.73
Total	860	378 (43.95)	482 (56.05)	25.92 ± 5.30

Values are presented as number only, number (%), or mean ± standard deviation.

Table 2. Comparison of OHIP-14 and PIDAQ scores between groups

	Group				ANOVA F	LSD <i>post-hoc</i> test
	1 (normal occlusion)	2 (malocclusion)	3 (fixed treatment)	4 (retention)		
OHIP-14	15.54 (7.33)	19.77 (7.81)	18.39 (8.01)	14.21 (8.05)	22.34 [†]	2, 3 > 1, 4
Functional limitation	2.38 (1.42)	3.56 (1.69)	2.72 (1.79)	2.33 (1.68)	23.93 [†]	2 > 3 > 1, 4
Physical pain	2.41 (1.64)	2.83 (1.62)	3.46 (1.52)	2.22 (1.58)	27.05 [†]	3 > 2 > 1, 4
Psychological discomfort	3.09 (1.66)	3.82 (1.58)	3.61 (1.66)	2.81 (1.62)	16.76 [†]	2, 3 > 1, 4
Physical disability	1.99 (1.38)	2.76 (1.61)	3.54 (1.58)	2.10 (1.52)	49.94 [†]	3 > 2 > 1, 4
Psychological disability	2.25 (1.79)	2.70 (1.98)	1.85 (1.77)	1.92 (1.77)	9.58 [†]	2 > 1 > 3 2 > 4
Social disability	1.84 (1.45)	2.05 (1.36)	1.67 (1.53)	1.56 (1.45)	4.61*	2, 1 > 4 2 > 3
Handicap	1.58 (1.45)	2.05 (1.61)	1.54 (1.53)	1.27 (1.43)	9.65 [†]	2 > 1 > 4 2 > 3
PIDAQ	26.72 (13.16)	46.65 (16.68)	41.21 (15.17)	27.38 (15.14)	91.87 [†]	2 > 3 > 1, 4
Dental self-confidence	11.13 (4.47)	16.84 (4.49)	14.38 (4.86)	9.74 (4.56)	100.37 [†]	2 > 3 > 1, 4
Social impact	6.09 (5.34)	11.76 (6.86)	11.07 (6.90)	6.61 (6.00)	45.77 [†]	2, 3 > 1, 4
Psychological impact	6.73 (4.00)	2.35 (4.69)	11.20 (4.02)	7.89 (4.28)	82.89 [†]	2, 3 > 1, 4
Aesthetic concern	2.78 (2.50)	5.70 (3.25)	4.56 (2.95)	3.14 (2.88)	44.37 [†]	2 > 3 > 1, 4

Values are presented as mean (standard deviation).

ANOVA, Analysis of variance; LSD, least significant difference; OHIP-14, Oral Health Impact Profile; PIDAQ, Psychosocial Impact of Dental Aesthetics Questionnaire.

* $p < 0.01$, [†] $p < 0.001$.

Table 3. Differences in OHIP-14 and PIDAQ between gender in each group

Group	OHIP-14			PIDAQ		
	Male	Female	<i>p</i> -value	Male	Female	<i>p</i> -value
1 (normal occlusion)	14.09 (6.07)	16.96 (7.66)	0.004 [†]	27.15 (13.59)	26.30 (12.78)	0.642
2 (malocclusion)	18.61 (7.70)	20.76 (7.79)	0.051	44.00 (15.97)	48.91 (17.01)	0.037*
3 (fixed treatment)	16.21 (8.15)	19.83 (7.61)	0.001 [†]	38.36 (13.90)	43.10 (15.72)	0.017*
4 (retention)	13.57 (8.34)	14.65 (7.85)	0.341	24.97 (13.06)	29.07 (16.35)	0.054

Values are presented as mean (standard deviation).

OHIP-14, Oral Health Impact Profile; PIDAQ, Psychosocial Impact of Dental Aesthetics Questionnaire.

* $p < 0.05$, [†] $p < 0.01$, [‡] $p < 0.001$ (by paired *t*-test).

and retention groups were less affected by oral health than the other two groups. Regarding the domains of the OHIP-14, the malocclusion group scored the highest in functional limitation, psychological discomfort, psychological disability, social disability, and handicap; it did not differ significantly from the fixed treatment group in psychological discomfort. The fixed treatment group scored the highest (statistically significant) in physical pain and physical disability (Table 2).

PIDAQ scores also differed significantly among groups ($p < 0.001$). *Post-hoc* analysis showed that PIDAQ score was the highest for the malocclusion group, followed

by the fixed treatment group, with the normal occlusion and retention groups having the lowest scores. These results indicate that the malocclusion group was the most psychosocially affected by dental esthetics. The normal occlusion and retention groups had higher OHRQoL than the malocclusion group. The malocclusion group scored the highest in all domains of the PIDAQ, although there were no significant differences compared with the fixed treatment group in the social impact and psychological impact domains (Table 2).

OHIP-14 scores were higher for women than for men across groups, with women scoring significantly higher

Table 4. Pearson's correlation coefficient between OHIP-14 and PIDAQ scores

	OHIP-14	PIDAQ
OHIP-14	1	
PIDAQ	0.482*	1

OHIP-14, Oral Health Impact Profile; PIDAQ, Psychosocial Impact of Dental Aesthetics Questionnaire.

* $p < 0.01$.

in the normal occlusion and fixed treatment groups. This indicates that women are more affected by oral health than are men, and that they experience lower OHRQoL. Women in the malocclusion and fixed treatment groups had significantly higher PIDAQ scores than did men, indicating that women in these groups were more psychosocially influenced by dental esthetics than were men in the same group. In addition, although men in the normal occlusion group had higher PIDAQ scores than women, this finding was not significant (Table 3).

Pearson's correlation coefficient between PIDAQ and OHIP-14 scores was significant ($r = 0.482$, $p < 0.01$), indicating a moderate positive association between the two questionnaires (Table 4).

DISCUSSION

Many factors affect OHRQoL; functional factors such as mastication, speech, and the experience of pain/discomfort, psychological factors concerning appearance and self-esteem, and social interactions are all contributors.¹³ The present study sought to identify the relationship between malocclusion and orthodontic treatment and OHRQoL in adults. The results showed that people with malocclusion had significantly lower OHRQoL, but when orthodontic treatment was completed, OHRQoL was increased to levels similar to normal occlusion.

The OHIP and OHIP-14 were originally developed to evaluate OHRQoL in the elderly.^{24,25} However, both have since been recognized as valid and reliable tools for evaluating OHRQoL in young adults and adolescents.^{26,27} An OHRQoL comparison study using the OHIP-14 reported that age, tooth loss, and cultural background are important factors that affect quality of life.²⁸ The present study limited its sample to subjects aged 18–39 years receiving fixed orthodontic treatment. Subjects were excluded if they had any extracted teeth, except for the purpose of orthodontic treatment. Patients who had undergone corrective orthognathic surgery were also excluded, as results of prior study²⁹ have shown that their experiences differ from the psychological status of typical adult orthodontic patients.

The results of this study showed that OHIP-14 scores

are greatly affected by oral health in the malocclusion and fixed treatment groups in comparison with the normal occlusion and retention groups. The malocclusion and fixed treatment groups were also found to have low OHRQoL; there was no significant difference between the malocclusion and fixed treatment groups, or between the normal occlusion and retention groups. In the present study, the areas of the OHIP-14 in which the fixed treatment group had higher scores were the domains of physical pain and physical disability. Discomfort and difficulty in taking meals due to orthodontic devices, pain due to tooth shifting, and irritation of the buccal mucosa may have contributed to these results. Additionally, the malocclusion group had a higher score than the fixed treatment group in the other 5 OHIP-14 domains. It is thought that the fixed treatment group had higher OHRQoL than the malocclusion group because the anticipation of the end of orthodontic treatment, adaptation to treatment, or learned experience of treatment may have served as psychologically positive influences.³⁰ This is also thought to be the reason why members of the fixed treatment group are less affected psychosocially with regard to dental esthetics in the PIDAQ compared to the malocclusion group (Table 2). Our results are comparable with those of recent studies that used the OHIP-14 or PIDAQ, which found that malocclusion has a negative impact on OHRQoL, and that this impact increases with the severity of malocclusion.^{15,16,31}

In our samples, the fixed orthodontic treatment group included patients who were receiving comprehensive orthodontic treatment using labial fixed orthodontic appliances, with no limitations regarding period or phase of treatment. In a longitudinal study conducted by Liu et al.,³² patients receiving comprehensive fixed orthodontic treatments were followed up before starting treatment and at 6, 12, and 18 months of treatment using the OHIP-14 and OHRQoL-UK to track their changes in OHRQoL. The authors found that patients generally reported a large decrease in OHRQoL in the first 6 months of orthodontic treatment, with OHRQoL improving as treatment continued. Chen et al.³³ compared OHIP-14 score changes in patients receiving treatment with fixed orthodontic appliances before treatment, 1 week after treatment, 1, 3, and 6 months during treatment, and after the end of treatment. The authors found that OHIP-14 score increased sharply 1 week after starting treatment, then decreased to below pre-treatment levels within 1 month; at the end of treatment, OHIP-14 score was significantly lower than before or during it. Thus, it could be considered that orthodontic treatment status influences quality of life, particularly in the initial phase of treatment.

In the present study, an investigation of possible

changes in OHRQoL based on gender showed that women had an overall lower quality of life than did men. Significant gender differences were found in the normal occlusion group ($p < 0.01$) and the fixed treatment group ($p < 0.001$) for the OHIP-14, as well as in the malocclusion group ($p < 0.05$) and the fixed treatment group ($p < 0.05$) for the PIDAQ (Table 3). In particular, OHIP-14 score in the normal occlusion group was 16.96 for women, which was higher than the score of 16.21 for men in the fixed treatment group. This implies that women are more affected by problems of the teeth and oral cavity than are men, even in cases of normal occlusion. Women may also respond more sensitively to the various forms of discomfort that arise in the oral cavity during orthodontic treatment. PIDAQ score did not differ significantly by gender in the normal occlusion or retention groups, but it could be observed that women in the malocclusion and fixed treatment groups were more affected psychosocially with regard to dental esthetics than were their male counterparts. Rusanen et al.¹⁴ investigated patients prior to treatment for severe malocclusion using the OHIP-14, and reported that women were more affected in terms of OHRQoL than were men. Bellot-Arcis et al.¹⁶ also observed that psychological impact increased with the severity of malocclusion, and that this trend was more pronounced in girls. However, Palomares et al.¹⁷ stated that an OHIP-14 survey of 18–30-year-old Brazilian adults on orthodontic treatment experience found a negligible difference in OHRQoL between genders. This lack of gender difference was also found in the study of Gazit-Rappaport et al.,¹⁸ which measured OHRQoL before and after orthodontic treatment using the PIDAQ in adults aged 21–59 years.

While the OHIP-14 questionnaire focuses on oral health, the PIDAQ is a survey tool that focuses on the psychosocial impact of issues related to dental esthetics. Despite this difference, the OHIP-14 and PIDAQ showed significant, moderate positive correlation ($r = 0.482$, $p < 0.01$). de Paula Júnior et al.³⁴ investigated the factors that affected PIDAQ score in adolescents, and found that these factors included the severity of malocclusion, OHIP-14 score, and body image. The Pearson correlation coefficient between the PIDAQ and OHIP-14 was significant ($r = 0.283$, $p < 0.05$), indicating a positive association, similar to the present findings. These results help to address the question of selecting a survey tool to use to measure OHRQoL in orthodontic patients. As the OHIP-14 and PIDAQ have established reliability and validity, and since they are highly correlated with each other, either of these tools may be used.

Lee³⁵ reported that women with malocclusion have low self-esteem, but that self-esteem rises to the level associated with normal occlusion after orthodontic

treatment. Furthermore, Kim³⁶ stated that in women in their twenties, those in the normal occlusion and retention groups had significantly better interpersonal relationships than those in the malocclusion and fixed treatment groups. The present study also showed that OHRQoL was significantly affected by malocclusion and orthodontic treatment. However, Shaw et al.⁶ reported that improvements in the severity of malocclusion through orthodontic treatment did not lead to significant differences in the psychological status of self-esteem or depressed mood when compared with a group that did not receive orthodontic treatment. Agou et al.¹⁹ also reported that, in a study of children aged 11–14 years, psychological well-being (PWB; an assessment of the frequency of feeling distress or happiness) is more highly correlated with OHRQoL than orthodontic treatment or malocclusion; when PWB was high, quality of life was high regardless of orthodontic treatment. Conversely, when PWB was low, children who had not received orthodontic treatment had a lower quality of life than children who had.

The present study has some limitations, and further discussion is necessary to promote relevant future research addressing these limitations. First, the study participants were arbitrarily chosen from patients who visited one of nine dental hospitals or clinics. Thus, it is possible that this study does not reflect the characteristics of normal occlusion or malocclusion patients who did not visit those dental clinics. Second, as this was a cross-sectional study, it did not include follow-up on changes in the quality of life of patients who have received orthodontic treatment. Since individual characteristics and various other factors may influence changes in quality of life, follow-up investigation is warranted through a long-term study.

CONCLUSION

The malocclusion group and the fixed treatment group reported significantly lower OHRQoL than the normal occlusion group and the retention group. Moreover, the malocclusion group perceived the strongest psychosocial impact related to dental esthetics. The normal occlusion and retention groups both reported the lowest psychosocial impact related to dental esthetics. OHRQoL was significantly affected by malocclusion and orthodontic treatment in both men and women, but especially in women. There was a significant correlation between the two instruments examined (the OHIP-14 and PIDAQ).

The number of adults receiving orthodontic treatment is increasing, and orthodontists must be able to accurately identify a patient's reasons for seeking treatment. This can be established through commu-

nicating with the patient and using OHRQoL questionnaires to provide additional useful information on specific aspects of orthodontic patients' psychological state.

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