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# Orthodontic pain is related to oral health-related quality of life in orthodontic patients

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## Abstract

**INTRODUCTION:** Orthodontic pain (OP) is a subjective experience induced by prolonged force on the teeth in fixed orthodontic treatment. OP acts as a predictor of aspects related to oral health-related quality of life (OHRQOL). It is important to understand the extent of the impact of OP on a patient's daily life, especially on stomatognathic function and social impact.

**OBJECTIVE:** To assess the correlation between OP and OHRQOL in fixed orthodontic treatment patients.

**MATERIAL AND METHODS:** The comparative pain rating scale is used to assess pain intensity, while the oral health impact profile-14 (OHIP-14) assesses the impact of OP severity on OHRQOL of 57 patients undergoing fixed orthodontic treatment in the early stages of treatment (1–3 months of treatment) at the Dental Hospital, Universitas Airlangga. Gender, age, and malocclusion classifications were also analyzed for their influence. The data were analyzed using Spearman correlation and two-way analysis of variance (ANOVA).

**RESULTS:** In the initial phase of treatment, most of the patients (53%) experienced mild OP and moderate OP (39%), and OP was reduced over a week. The overall OHRQOL score was  $17.4 \pm 8$ , which indicates a negative impact on OHRQOL. There were also positive correlation dimensions of OHRQOL, which include the dimensions of physical limitations, psychological discomfort, and psychological limitations ( $r > 0.50$ ). There was a significant difference between age groups in OP perception and OHRQOL ( $P < 0.05$ ).

**CONCLUSIONS:** There was a positive correlation between OP intensity and OHRQOL experienced by fixed orthodontic patients at the Dental Hospital, Universitas Airlangga.

## Keywords:

Medicine, OHIP-14, oral health-related quality of life, orthodontic pain, orthodontic treatment, quality of life

## Introduction

Orthodontic therapy aims to shift teeth to the appropriate position by using mechanical orthodontic force, which causes alveolar bone response and tooth movement.<sup>[1–3]</sup> Fixed orthodontic therapy is intended to promote the functional and structural balance of the stomatognathic system as well as dental-muscular harmony.

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In terms of tooth movement and force applications, around 90–95% of patients report pain and discomfort as treatment side effects.<sup>[4,5]</sup> Almost all orthodontic treatment procedures, including separator installation, activation of orthopedic forces, and debonding, cause discomfort. However, arch wire placement was shown to be the most painful.<sup>[6,7]</sup>

Even though these symptoms are more than simply sensation and might impair

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patients' everyday lives, most orthodontic practitioners do not pay enough attention to the patient's pain. It can cause functional changes such as poor mastication and speech, as well as affect a person's psychological state by causing worry and emotional stress. Orthodontic discomfort is one of the leading causes of missed visits and noncompliance with treatment. OP is the reason that 10–30% of patients abandon therapy in the early stages.<sup>[7,8]</sup> Patient overall treatment expectations and treatment quality might also be influenced, which could be a key factor impacting patients' OHRQOL.<sup>[9–11]</sup>

OHRQOL testing is critical for evaluating patients' subjective experiences with oral health care. The OHIP-14 is a reliable, accurate, and precise instrument that attempts to evaluate the extent to which dental problems might affect the quality of life.<sup>[12,13]</sup> OHIP-14 assesses three conceptual domains of OHRQOL, which include physical, psychological, and social well-being. Items are distributed to seven dimensions elaborated from Locker's theoretical model. These seven dimensions include functional limitations, physical discomfort, psychological discomfort, physical disability, psychological disability, social disability, and handicap.<sup>[14,15]</sup> Recognizing that pain is a subjective response and feeling and that each individual has their own standard of OHRQOL, the researchers would like to research the relationship of OP to OHRQOL in fixed orthodontic patients at Dental Hospital, Universitas Airlangga in Surabaya, East Java, Indonesia.

## Materials and Methods

Following ethical permission (No: 7/UN3.9.3/Etik/PT/2022), a descriptive cross-sectional study was undertaken at the Department of Orthodontics, Dental Hospital, Universitas Airlangga, Surabaya from July 2022 to November 2022. The convenience sample approach was used to choose 57 patients having fixed orthodontic treatment. Patients who were eligible to participate in the trial were asked to fill out a written informed consent form. The Lemeshow's formula was used to compute the minimum sample size. The inclusion criteria comprised patients aged 12–30 years who were having early fixed orthodontic treatment (1–3 months of treatment) using conventional fixed orthodontic appliances with 0.22 slot. Patients receiving fixed orthodontic treatment for more than 3 months, patients with severe Class II or Class III who required orthognathic surgery, patients on analgesic medication, and patients who refused to complete the questionnaire were eliminated.

The pain was examined using a comparative pain scale throughout the first 3 months of fixed orthodontic treatment. This scale subjectively analyzes individual pain on an 11-point numerical scale and 11 facial

expression photographs, ranging from 0 (no pain at all) to 10 (unimaginable anguish). Mild pain = 0–3 (very mild, discomforting, acceptable, bothersome, does not interfere with most daily living activities); moderate pain = 4–6 (interferes considerably with daily living activities); severe pain = 7–10 (disabling; unable to conduct daily living activities). Pain characteristics are also assessed to determine the onset and duration of pain. Using Indonesian versions, an online self-reported questionnaire was used to record OHIP-14. OHIP-14 is made up of 14 measures that reveal seven daily effect dimensions: functional constraint, bodily pain, psychological discomfort, physical disability, psychological disability, social impairment, and handicap. The replies were categorized as "very often" (scoring 4), "pretty often" (3), "sometimes" (2), "hardly ever" (1), or "never" (0) using a Likert scale. Higher OHIP-14 ratings imply a greater influence on oral health. Before collecting data for the main study, 11 patients with fixed orthodontic treatment were tested for questionnaire reliability. The internal consistency of the questionnaire, according to Cronbach's alpha, was 0.92, which suggests high reliability. The collected data were entered and tabulated in Microsoft Excel before being analyzed using Spearman's correlation test and two-way ANOVA in the statistical package for social science version 20.0 (IBM Corporation, Illinois, Chicago, USA).

## Results

Out of 57 patients, 47 (82%) were female and 10 (18%) were male. The average age of the research participants was 23.12 ± 6.38 years old. Angle's malocclusion class I is the most common. The majority of patients (53%) reported mild pain, 39% reported moderate pain, and 2–7% reported no discomfort or severe pain [Table 1]. The mean pain score of all research participants throughout the early phases of fixed orthodontic treatment was 3.74 ± 1.74, which was classified as mild to moderate discomfort. Discomfort characteristics were also assessed, and the majority of trial participants (46%) reported discomfort increasing 6 hours after orthodontic force application and decreasing a week later (58%) [Tables 2 and 3]. The Spearman correlation test was used to examine the relationship between OP intensity and OHRQOL. Spearman's correlation test determines the direction of the link between two variables: OP intensity and

**Table 1: Pain intensity distributions**

Score	Pain intensity	Frequency (n)	Percentage
0	No pain	1	2
1-3	Mild pain	30	53
4-6	Moderate pain	22	39
7-10	Severe pain	4	7
Total		57	100

OHRQOL as evaluated by each subscale of the OHIP-14 instrument. The research participants have encountered more than one detrimental outcome of fixed orthodontic therapy on their dental health [Table 4]. According to Spearman’s correlation test, the subscales of “interrupted while eating,” “felt anxious,” and “difficult to relax” had a high correlation test result ( $r = 0.60$ ), which suggests a significant link [Table 5]. In addition, Figure 1 depicts the direction of the link between the two variables.

Meanwhile, the handicap dimension with the “totally unable to move” subscale shows a very poor link with a correlation coefficient ( $r = 0.05$ ). The study participants’ age, gender, and malocclusion categorization were also examined using a two-way ANOVA on pain severity and quality of life factors. Based on the analytical test on different age groups with a two-way ANOVA, it appears that different age groups had a significant influence on OP intensity and OHRQOL. The *P*-values for different gender groups and malocclusion classifications suggest that there is no significant influence on OP severity and OHRQOL [Table 6].

**Table 2: Pain onset distributions**

Onset	Frequency (n)	Percentage
1-2 hours after force applications	15	26
6 hours after force applications	26	46
12 hours after force applications	9	16
24 hours after force applications	7	12
Total	57	100

**Table 3: Pain duration distributions**

Duration	Frequency (n)	Percentage
Less than 1 week	33	58
1 week	16	28
More than 1 week	8	14
Total	57	100

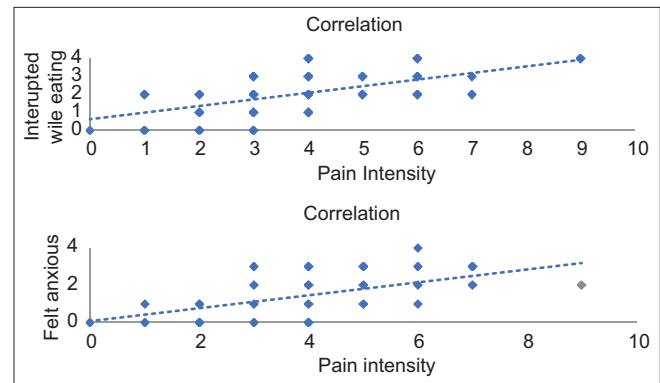
**Table 4: Distribution of responses to the OHIP-14 questionnaire**

Questions	Response					Overall impact (score 1-4)
	Never (%)	Hardly ever (%)	Occasionally (%)	Fairly often (%)	Very often (%)	
Trouble on pronouncing words	16 (0.28)	28 (0.49)	8 (0.14)	4 (0.07)	1 (0.02)	41 (0.72)
Worsens sense of taste	37 (0.65)	12 (0.21)	5 (0.09)	2 (0.04)	1 (0.02)	20 (0.35)
Pain in the oral cavity	8 (0.14)	10 (0.18)	27 (0.47)	12 (0.21)	0 (0)	49 (0.86)
Pain when chewing food	2 (0.04)	2 (0.04)	19 (0.33)	22 (0.39)	12 (0.21)	55 (0.96)
Felt anxious	14 (0.25)	18 (0.32)	17 (0.3)	7 (0.12)	1 (0.02)	43 (0.75)
Felt worry	15 (0.26)	19 (0.33)	19 (0.33)	4 (0.07)	0 (0)	42 (0.74)
Not satisfied to the food consumed	5 (0.09)	14 (0.25)	14 (0.25)	16 (0.28)	8 (0.14)	52 (0.91)
Interrupted while eating	7 (0.12)	7 (0.12)	27 (0.47)	11 (0.19)	5 (0.09)	50 (0.88)
Difficulty to relax	14 (0.25)	19 (0.33)	20 (0.35)	4 (0.07)	0 (0)	43 (0.75)
Been a bit embarrassed	38 (0.67)	11 (0.19)	8 (0.14)	0 (0)	0 (0)	19 (0.33)
Been irritable to others	32 (0.56)	15 (0.26)	10 (0.18)	0 (0)	0 (0)	25 (0.44)
Difficulty doing usual activities	20 (0.35)	20 (0.35)	16 (0.28)	1 (0.02)	0 (0)	37 (0.65)
Life felt less satisfying	24 (0.42)	18 (0.32)	10 (0.18)	4 (0.07)	1 (0.02)	33 (0.58)
Totally unable to function	44 (0.77)	10 (0.18)	3 (0.05)	0 (0)	0 (0)	13 (0.23)

## Discussion

The majority of research participants (97%) reported orthodontic discomfort throughout the earliest phases of therapy. The majority of patients (54%) reported mild discomfort, 37% reported moderate pain, and 5% reported severe pain. This data supports the idea of tooth movement, which states that only frontal resorption occurs when optimal or minimal pressure is applied. This results in quick tooth movement, limited root resorption, and minimal unfavorable effects on patients.<sup>[16-18]</sup>

The average pain intensity indicates that the majority of study participants felt mild to moderate pain. The majority of patients feel moderate discomfort throughout fixed orthodontic treatment.<sup>[19,20]</sup> A small proportion (5%) of patients reported severe pain, which could be due to differences in pain perception among patients, in which subjective response pain is felt by each individual, as well as factors influencing perception such as cultural differences and patients’ condition while filling out the questionnaire.<sup>[17,19,20]</sup>



**Figure 1:** The direction of the link between the two variables: interrupted while eating and pain intensity; felt anxious and pain intensity

The majority of patients (46%) reported discomfort after 6 hours of orthodontic pressure applications, which gradually subsided after 3–7 days. This pain is classified as a delayed pain response, which is pain felt several hours after implantation or orthodontic pressure. The pain is due to partial compression of the ligament periodontal, which can produce hyperalgesia and lower the patient’s pain threshold.<sup>[17,21]</sup> As a result, the application of various orthodontic forces and pressures might be interpreted as causing very intense pain during the first 3 days of treatment. This is the most common reason for the early use of analgesics or pain medications in patients with permanent appliances.<sup>[6,22]</sup>

The mean OHIP-14 score was  $17.4 \pm 8.0$ , which shows that OP has a negative impact on OHRQOL and that practically all OHIP-14 dimensions were significantly influenced in the early phases of therapy. The fundamental explanation is that individuals are still adjusting to wearing a permanent device, which is regarded as a foreign item in the oral cavity, and hence, abnormalities in the dimension of OHIP-14 have been documented. These findings are consistent with previous studies that found that patients who use

fixed orthodontic appliances have a higher likelihood of reporting a negative impact on OHRQOL, such as disruption in daily activities, than patients who do not use fixed orthodontic appliances.<sup>[6,23]</sup>

Physical restrictions and physical discomfort were the aspects of OHIP-14 that were most influenced by this research. Of all respondents, 88% reported eating interruptions, which is corroborated by a significant coefficient of association. These data suggest that pain intensity is the primary reason patients suffer food disruption. The frequency of pain and discomfort while eating was consistent with three previous studies that demonstrated disruption of the eating process may be caused by a fear that orthodontic components will fall off while eating, as well as tooth sensitivity during orthodontic tooth movement.<sup>[6,13,24]</sup> In addition, orthodontic discomfort alters patients’ food consumption.<sup>[19]</sup> In this scenario, the practitioner may counsel the patient that the disruption and discomfort while eating are transitory and will improve with time. The practitioner may also advise the patient to follow a soft diet and avoid sticky foods for a few days to avoid excessive pain when eating.<sup>[25–27]</sup>

One of the three conceptual areas of OHRQOL explored in this study is the patient’s psychological condition. In terms of psychological discomfort, 75% of patients reported feeling nervous and disturbed while having fixed orthodontic treatment, which is corroborated by a strong correlation coefficient between pain severity and quality of life (OHRQOL). These findings are consistent with previous studies that discovered a reduction in the patient’s psychological state induced by the experience of OP and persistent discomfort.<sup>[26,28]</sup> Based on the cortisol hormone, pain and anxiety have a physiological link. Orthodontic discomfort functions as an external stressor that activates the synthesis of this hormone, which raises blood pressure, nausea, and anxiety. Individual stress situations can also lower a person’s pain threshold value and make the patient more susceptible to pain stimuli.<sup>[29–31]</sup>

**Table 5: Spearman coefficient correlation test results**

Oral health-related quality of life (OHRQOL)		r	Correlation
Dimension	Questions		
Functional limitations	Trouble on pronouncing word	0.07	Very low
	Worsens sense of taste	0.38	Moderate
Physical pain	Pain in the oral cavity	0.55	Moderate
	Pain when chewing food	0.41	Moderate
Psychological discomfort	Felt anxious	0.57	Moderate
	Felt worry	0.40	Moderate
Physical disability	Not satisfied to the food consumed	0.41	Moderate
	Interrupted while eating	0.60	Strong
Psychological disability	Difficulty to relax	0.56	Moderate
	Been a bit embarrassed	0.24	Low
Social disability	Been irritable to others	0.25	Low
	Difficulty doing usual activities	0.49	Moderate
Handicap	Life felt less satisfying	0.22	Low
	Totally unable to function	0.05	Very low

**Table 6: Two-way ANOVA results on different groups of age, gender, and malocclusion classification**

	Mean pain intensity	Mean OHIP-14 score	P
Age			
<18 age	4.75	21.5	0.003418
18-30 age	3.81	18.25	
>30 age	3	13.67	
Gender			
Female	3.77	17.70	0.5796
Male	3.73	16.27	
Angle’s Classification of Malocclusion			
Angle’s Class I Malocclusion	3.83	17.19	0.9134
Angle’s Class II Malocclusion	3.64	16.55	
Angle’s Class III Malocclusion	3.33	16.56	

On the psychological constraint dimensions, 76% of patients reported difficulties relaxing. The Spearman correlation value was likewise significant, demonstrating a substantial association between the degree of orthodontic discomfort and the difficulty for patients to rest. This study's findings were consistent with those of previous studies in which patients reported difficulties sleeping and relaxing. This might be due to a more difficult adaptation to the new orthodontic components inserted in the patient's mouth cavity.<sup>[6,32]</sup> Pain, pressure, tension, and discomfort, as well as high levels of worry, can lead patients to be more awake and find it harder to relax, which affects their sleep quality. However, these findings contradict those of previous studies which found no significant difference in difficulty sleeping between fixed-device patients and Invisalign™ patients.<sup>[33-35]</sup>

The poor correlation on the "felt ashamed" subscale on the same dimension, psychological limits, shows a weak association between pain intensity. This is corroborated by the findings that the use of fixed orthodontic appliances was less appealing in terms of appearance than that of those who did not use permanent appliances, which influences patients' psychological well-being.<sup>[25,36]</sup> The aspects of OHRQOL that were not substantially influenced in this study were functional restrictions and handicap dimensions, which were substantiated by low correlation coefficient values. A low Spearman coefficient correlation revealed a very poor link between pain intensity and decreasing sensation of taste on the functional limits scale. This conclusion is corroborated by a previous study that indicated that patients with removable orthodontic equipment are more likely to have taste abnormalities. This is due to the device's components covering the palatal surface, which has a high sensory taste and obstructing airflow in the oral and nasal canals. All these things can induce alterations in taste perception.<sup>[37]</sup> The patient's difficulty speaking is not caused by high pain intensity. This finding is consistent with previous studies that found speech disorders when pronouncing vowels such as /i/, /u/, and /a/, as well as consonants such as /s/, /t/, /f/, and /l/, were caused by the placement of orthodontic appliance components that attach to the palate and tooth surfaces. Lingual orthodontic appliances were found to cause more speech disturbances than labial orthodontic appliances. This was due to the placement of the brackets on the lingual surface of the teeth, which could affect tongue movement and cause distortion when pronouncing certain sounds.<sup>[38,39]</sup>

This study also examines patient variables such as age, gender, and malocclusion classifications on OP severity and their influence on OHRQOL. In terms of age, it has been discovered that patients with younger ages have

higher pain intensity and, therefore, lower quality of life. The two-way ANOVA test result also revealed a significant relationship between the age difference and the variables of OP intensity and OHRQOL that were influenced. The older people had higher pain threshold values than the younger ones, resulting in decreased pain intensity.<sup>[40]</sup> However, this finding varies in that using fixed orthodontic equipment increases tolerance and adaptability to pain and discomfort in younger patients. The presence of these disparities may be connected to cultural and environmental characteristics of the research and research design, which might impact pain intensity scores and quality of life measurements.<sup>[33,40]</sup>

OP perception and OHRQOL measurement can be influenced by gender variations between men and women. According to earlier research, women's pain intensity and OHIP-14 score were shown to be greater. Because estrogen hormone levels in women enhance osteoclast activity, orthodontic tooth movement becomes more rapid during menstruation.<sup>[41]</sup> Women also have lower pain threshold values, are more sensitive, and have more self-awareness. Therefore, they report problems in their mouth cavities more frequently than men.<sup>[42-44]</sup> The average OP intensity and OHIP-14 score in female patients were found to be somewhat greater than in male patients in this research. This finding might be attributed to the uneven number of female and male respondents, which influenced data processing. The findings of this study are consistent with those of previous studies in that there is no significant change in the degree of quality of life in patients.<sup>[23,27]</sup> In addition, gender is not a predictive factor for pain experience.<sup>[23,27,45]</sup>

Malocclusion categorization differences can influence OP perception and OHRQOL assessments. Angle's categorization of the malocclusion determines fixed orthodontic appliance treatment plans, such as the kind of tooth movement necessary, the space required for tooth movement, and whether a tooth extraction or nonextraction treatment plan is considered. This study found that patients with an Angle Class I malocclusion had greater OP intensity and OHRQOL assessments. Tooth extraction is typical in this classification to make room for tooth movement. In situations of extraction, higher tooth movement is predicted, which results in increased discomfort and sensitivity. However, according to the findings, various Angle malocclusion groups had no significant effect on the factors assessed. Previous studies also discovered no significant difference between the extraction and nonextraction patient groups, as well as no association between the initial tooth location, the force used, and pain experience.<sup>[10,17]</sup>

Keeping in mind that pain is a subjective experience with varied values from case to case, this study has various

limitations in assessing pain intensity, such as orthodontic force used during the initial phase of treatment, the kind of tooth movement, the patient's mental state throughout the measuring time, cultural variations, socioeconomic status, and previous pain experience. The possibility of soft tissue lesions because of the use of fixed orthodontic equipment is not recorded but can potentially contribute to pain and discomfort sensations. Furthermore, because patients' OHRQOL before orthodontic treatment was not documented, it was not feasible to compare how much of a loss in OHRQOL occurred following the insertion of fixed orthodontic appliances.<sup>[33,46]</sup> With the characteristics of OHRQOL that are most severely affected in this study, it may now be used as a guideline for practitioners in controlling the daily impact or disruption of orthodontic discomfort, particularly during the early phase of treatment. Practitioners frequently inform patients that their OHRQOL may improve progressively over time. Understanding and effective communication between practitioners and patients can therefore promote patients' cooperation and compliance throughout therapy and result in better treatment results for both patients and practitioners.<sup>[6,19,47]</sup>

## Conclusion

OP and assessment of OHRQOL are subjective experiences, with most patients reporting mild to moderate pain. Physical limits, psychological restrictions, and psychological discomfort dimensions are the aspects of OHRQOL most influenced by OP. Different age groups have a substantial influence on OP perception and OHRQOL; however, different genders and malocclusion classes had no significant effect on OP perception and OHRQOL.

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## Ethical policy and Institutional Review board statement

Health Committee research Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia approved the study protocol.

## Patient declaration of consent statement

The patients confirmed and agreed to participate in the study by filled written informed consent and written informed to consent form.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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