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Patient-Reported Adverse Conditions and Acceptance During Fixed Orthodontic Treatment

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Abstract

Background: Orthodontic treatment is associated with a range of adverse conditions. Understanding the occurrence of these conditions, patient acceptance, and their interrelationships is necessary to optimize patient experience and to inform clinical communication during fixed orthodontic treatment. **Objective:** This study aimed to investigate patient-reported adverse conditions experienced during fixed orthodontic treatment, evaluate patient acceptance of these conditions, and examine the associations between condition occurrence, patient characteristics, and acceptance. **Materials and methods:** A descriptive cross-sectional study was conducted among 219 patients who had completed fixed orthodontic treatment at the Orthodontic Clinic, Prince of Songkla University. Respondents reported adverse conditions experienced during treatment and whether they accepted each condition, using an online questionnaire. Descriptive statistics summarized the proportion of patients reporting adverse conditions and acceptance. Associations between demographic variables, adverse conditions, and acceptance were analyzed using the Mann-Whitney U-test and chi-square test. **Results:** All respondents reported experiencing pain during treatment. Appliance or wire detachment was the most common condition (73.52 %), while dental caries was the least reported (28.31 %). Most respondents indicated acceptance of the adverse conditions encountered during treatment. Acceptance differed significantly according to occurrence status for dental caries, halitosis, increased calculus formation, preauricular pain/tightness/fatigue, and poking from appliances or wires (P = 0.001–0.015). **Conclusion:** Patients reported multiple adverse conditions during fixed orthodontic treatment, and acceptance was generally high. Acceptance differed according to occurrence status for five adverse conditions; however, the distinction between experienced and hypothetical acceptance should be considered when interpreting these associations.

Keywords: Acceptance, Adverse condition, Orthodontic treatment, Questionnaire, Survey

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Introduction

Orthodontic treatment is recognized for its ability to improve occlusion, dental esthetics, and overall quality of life.[1] Although these benefits are well established, many patients experience temporary adverse effects during treatment that may affect comfort and the overall treatment experience.[2]

Adverse conditions may arise during fixed orthodontic treatment as a result of mechanical forces, irritation from appliance components, and challenges in maintaining oral hygiene.[3] Pain is the most frequently reported condition, typically beginning within 24 hours after appliance activation.[4] Pain and discomfort are common during orthodontic procedures and may persist for several days.[5]

Other adverse conditions include dental caries and enamel demineralization. Early demineralization, often presenting as white spot lesions, is well documented.[6] Chapman et al. reported that 36 % of patients developed at least one white spot lesion on the labial surfaces of the anterior maxillary teeth during fixed orthodontic treatment.[7] Halitosis is another potential adverse condition during fixed orthodontic treatment. Fixed orthodontic appliances may increase oral malodor, partly because appliance components facilitate plaque retention and make oral hygiene more challenging.[8,9] Fixed orthodontic appliances may also be associated with increased plaque and calculus accumulation.[10] Bracket placement can alter subgingival microbiota and increase plaque accumulation, gingival inflammation, and bleeding.[11]

Some patients experience temporomandibular symptoms, including joint pain, clicking, or limited mouth opening during treatment.[12] Although available evidence does not support a simple causal relationship between orthodontic treatment and temporomandibular disorders, TMD signs and symptoms may occur independently of orthodontic treatment.[13]

Soft-tissue irritation caused by protruding wires or appliance components is another frequently observed condition and may result in ulcerations of the cheeks, lips, or gingiva.[14,15] Appliance or wire detachment can prolong treatment and contribute to discomfort.[16,17]

Although numerous adverse conditions during orthodontic treatment have been described in the literature, studies examining the frequency of these conditions and patient perceptions of their acceptability remain limited. Most existing research focuses on prevalence, with few studies assessing whether patients consider each condition acceptable or unacceptable. It also remains unclear whether acceptance differs between patients who have actually experienced a condition and those evaluating it hypothetically. This gap limits orthodontists' ability to anticipate patient concerns and provide appropriate guidance. The present study aimed to investigate patient-reported adverse conditions experienced during fixed orthodontic treatment, evaluate patient acceptance of these conditions, and examine the associations between condition occurrence, patient characteristics, and acceptance.

Materials and methods

Because no existing instrument comprehensively assessed both adverse conditions and their acceptance during fixed orthodontic treatment, a self-administered questionnaire was developed through a multistep process. The initial draft was prepared using information from previous studies describing orthodontic treatment–related pain, white spot lesions, halitosis, calculus formation, temporomandibular symptoms, soft-tissue irritation, and appliance failure[4–17] together with informal interviews. Content validity was evaluated by three experts, comprising two orthodontists and one research methodology specialist. The questionnaire achieved a Content Validity Index (CVI) of 0.98. After receiving approval from the Human Research Ethics Committee of the Faculty of Dentistry, Prince of Songkla University, the questionnaire was pilot tested with individuals whose characteristics were similar to those of the target population. The pilot test assessed

language clarity, item comprehension, and overall reliability. Based on the pilot data, the questionnaire demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.78. Feedback from the pilot phase was used to revise the instrument before final use.

The final questionnaire consisted of three components. The first component collected demographic information, including gender, age at the start of treatment, educational level, and the primary reason for seeking orthodontic care. Respondents who selected both esthetic and functional reasons were asked to identify the main reason. The second component addressed adverse conditions experienced during treatment. Respondents indicated whether they had experienced specific conditions, including pain, dental caries, halitosis, increased calculus formation, discomfort or tightness around the preauricular area, poking from appliances or wires, and appliance or wire detachment. Pain was rated on a numeric scale from 0 to 10, while the remaining conditions were assessed using binary response options. The third component focused on acceptance. For each condition that respondents had experienced, they reported whether they accepted the condition based on their actual experience. For conditions they had not experienced, they reported whether they would hypothetically accept the condition if it occurred.

The study population included patients who completed fixed orthodontic treatment between July 2021 and July 2022 at the Dental Hospital, Faculty of Dentistry, Prince of Songkla University. Eligible participants were patients who had completed treatment primarily with fixed orthodontic appliances, had complete treatment records, were contactable by telephone, and were at least 18 years old at the time of questionnaire completion. Patients who temporarily used adjunct removable appliances during conventional fixed orthodontic treatment were not excluded, because fixed appliances remained the primary treatment modality throughout the overall treatment course. Exclusion criteria included patients who received combined orthodontic and orthognathic treatment, had cleft lip and/or palate, or underwent repeat orthodontic treatment. A total of 578 patient records were screened. After applying the eligibility criteria, all 465 eligible patients were contacted and invited to participate. Because the study attempted to recruit the entire accessible eligible population rather than a predetermined sample, no prospective sample-size calculation was performed. A total of 219 patients completed the questionnaire, corresponding to a response rate of 47.10 %. Data collection was carried out between February and March 2023. The mean interval between treatment completion and questionnaire completion was 11.0 months (range, 7–20 months). The questionnaire was administered online through Google Forms, and the survey link was sent to the respondent via the LINE application. A total of 219 respondents completed the questionnaire and were included in the analysis.

Descriptive statistics were used to summarize demographic characteristics, the self-reported occurrence of adverse conditions, experienced acceptance, and hypothetical acceptance. For each condition other than pain, the proportions of respondents who accepted the condition were compared between those who had and had not experienced it using the chi-square test. Associations of condition-specific acceptance with gender, educational level, and primary treatment motivation were also examined using the chi-square test. Because all respondents reported experiencing pain, pain scores were compared between respondents who accepted and did not accept pain using the Mann–Whitney U test. Statistical significance was set at $P < 0.05$.

Results

General data

A total of 219 respondents were included in the analysis. As shown in Table 1, the majority of respondents were female. The mean age at the start of treatment was 20.66 years, with a range of 11 to

56 years. When categorized by age group, most respondents were younger than 20 years. More than half of the respondents were studying for or had completed a bachelor's degree or higher. Esthetic concerns were the primary reason for seeking orthodontic treatment.

Table 1 General demographic data of the respondents

General data	Respondents (n(%))
Gender	
Male	47 (21.46)
Female	172 (78.54)
Age at the start of treatment	
Younger than 20 years	126 (57.53)
20 – 29 years	65 (29.68)
30 – 39 years	19 (8.68)
40 years or older	9 (4.11)
Education at the start of treatment	
Below bachelor's degree	99 (45.21)
Bachelor's degree or higher	120 (54.79)
Main reason for seeking treatment	
Esthetic concerns	167 (76.26)
Functional concerns	52 (23.74)

Adverse Conditions During Treatment

All respondents reported experiencing pain during treatment. Severe pain (scores 7–10) was the most frequently reported category, accounting for 47.49 % of respondents, as presented in Table 2. The occurrence of other adverse conditions is summarized in Table 3. The reported adverse conditions included dental caries (28.31 %), halitosis (36.53 %), increased calculus formation (61.64 %), preauricular pain, tightness, or fatigue, including worsening of pre-existing symptoms (31.51 %), poking from orthodontic appliances or wires (70.32 %), and appliance or wire detachment (73.52 %).

Table 2 Pain level during treatment reported by respondents

Level of pain	Respondents (n(%))
Mild pain (Score 1-3)	25 (11.42)
Moderate pain (Score 4-6)	90 (41.10)
Severe pain (Score 7-10)	104 (47.49)

* Percentages may not total 100 % due to rounding.

Acceptance of Adverse Conditions

As shown in Table 4, acceptance among respondents who experienced each adverse condition was high: pain (99.09 %), dental caries (85.48 %), halitosis (91.25 %), increased calculus formation (91.85 %), preauricular symptoms (88.41 %), poking from appliances or wires (88.96 %), and appliance or wire detachment (93.79 %). In comparison, acceptance

Table 3 Self-reported occurrence of adverse conditions during fixed orthodontic treatment

Adverse conditions during treatment	Respondents (n(%))	
	Occurrence	No occurrence
Pain	219 (100.00)	0 (0.00)
Dental caries	62 (28.31)	157 (71.69)
Halitosis	80 (36.53)	139 (63.47)
Increased calculus formation	135 (61.64)	84 (38.36)
Preauricular pain/tightness/fatigue	69 (31.51)	150 (68.49)
Poking from appliances or wires	154 (70.32)	65 (29.68)
Appliance or wire detachment	161 (73.52)	58 (26.48)

Table 4 Experiential acceptance among respondents who reported experiencing each adverse condition

Acceptance of adverse conditions reported by respondents who experienced those adverse conditions	Respondents (n(%))	
	Accept	Do not accept
Pain	217 (99.09)	2 (0.91)
Dental caries	53 (85.48)	9 (14.52)
Halitosis	73 (91.25)	7 (8.75)
Increased calculus formation	124 (91.85)	11 (8.15)
Preauricular pain/tightness/fatigue	61 (88.41)	8 (11.59)
Poking from appliances or wires	137 (88.96)	17 (11.04)
Appliance or wire detachment	151 (93.79)	10 (6.21)

Table 5 Hypothetical acceptance among respondents who did not report experiencing each adverse condition

Acceptance of adverse conditions reported by respondents who did not experience those adverse conditions	Respondents (n(%))	
	Accept	Do not accept
Dental caries	109 (69.43)	48 (30.57)
Halitosis	102 (73.38)	37 (26.62)
Increased calculus formation	67 (79.76)	17 (20.24)
Preauricular pain/tightness/fatigue	110 (73.33)	40 (26.67)
Poking from appliances or wires	49 (75.38)	16 (24.62)
Appliance or wire detachment	52 (89.66)	6 (10.34)

among respondents who did not experience the adverse condition, as presented in Table 5, was lower: dental caries (69.43 %), halitosis (73.38 %), increased calculus formation (79.76 %), preauricular symptoms (73.33 %), poking from appliances or wires (75.38 %), and appliance or wire detachment (89.66 %).

Relationships Between Factors and Acceptance

As shown in Table 6, no significant associations were found between acceptance and gender, educational level, or the primary reason for seeking treatment. However, significant associations were observed between acceptance and five adverse conditions: dental caries (P = 0.015), halitosis (P = 0.001), increased calculus formation (P = 0.009), preauricular pain/tightness/fatigue (P = 0.012), and poking from appliances or wires (P = 0.010). These findings indicate that condition-specific acceptance differed according to occurrence status for these five adverse conditions.

Discussion

Significant associations between occurrence status and condition-specific acceptance were observed for five adverse conditions. These findings should not be interpreted as evidence that the occurrence of adverse conditions determined patients' overall treatment experiences, because treatment continuation,

Table 6 *P* values for associations between acceptance of adverse conditions and condition occurrence or pain score and participant characteristics

Acceptance of adverse condition	Condition occurrence / pain score	Gender	Education	Main reason for seeking treatment
Pain	0.224[a]	0.323[b]*	0.891[b]*	1.000[b]
Dental caries	0.015[b]	0.507[b]	0.190[b]	0.847[b]
Halitosis	0.001[b]	0.522[b]	0.083[b]	0.859[b]
Increased calculus formation	0.009[b]	0.326[b]	0.174[b]	0.486[b]
Preauricular pain/tightness/fatigue	0.012[b]	0.605[b]	0.669[b]	0.567[b]
Poking from appliances or wires	0.010[b]	0.378[b]	0.121[b]	0.376[b]
Appliance or wire detachment	0.300[b]*	0.507[b]	0.149[b]	0.768[b]

[a] Mann–Whitney U-test

[b] chi-square test.

* For values marked with an asterisk, at least one expected cell count was less than 5; therefore, the chi-square result should be interpreted with caution.

For pain, the first *P* value column represents the association between acceptance and pain score. For all other adverse conditions, it represents the association between condition-specific acceptance and occurrence status.

satisfaction, and adherence were not directly assessed. Acceptance-based frameworks suggest that willingness to experience discomfort can coexist with continued pursuit of valued treatment goals.[18] Experimental evidence also suggests that treatment-related side effects can influence expectations regarding treatment efficacy.[19] However, these psychological mechanisms were not directly assessed in the present study.

When considering the self-reported occurrence of adverse conditions in this study, pain was the side effect experienced by all respondents. Previous studies have likewise shown that pain is common during the early stages of orthodontic treatment. Bergius et al. reported that 48 of 55 patients (87.27 %) experienced pain on the first evening after placement of molar separators, with pain intensity reaching its highest level the following day.[5] Ngan et al. found a significant increase in discomfort at 4 and 24 hours after placement of separators or initial archwires, whereas discomfort was no longer significantly elevated at 7 days.[20] These findings indicate that pain is an almost unavoidable side effect of fixed orthodontic treatment. Despite the high occurrence of pain, acceptance remained high among respondents. Pain may have been widely accepted because it is commonly anticipated as an unavoidable part of orthodontic treatment and is generally perceived as temporary.

Dental caries was self-reported by 28.31 % of respondents in the present study. Direct comparison with previous studies should be made cautiously because most previous studies assessed white spot lesions, which represent early enamel demineralization rather than cavitated dental caries. Gorelick et al. reported that 49.60 % of orthodontic patients developed at least one white spot lesion during treatment.[21] Øgaard found that orthodontically treated individuals had significantly more teeth with white spot lesions than untreated individuals more than five years after treatment.[6] Julien et al. reported that 23.40 % of patients developed at least one white spot lesion during orthodontic treatment.[22] In a meta-analysis, Sundararaj et al. reported pooled incidence and prevalence rates of 45.80 % and 68.40 %, respectively.[23] The lower self-reported occurrence in the present study may therefore reflect

differences in outcome definition and assessment method, as well as possible under-recognition by patients.

Soft-tissue irritation and oral mucosal lesions are recognized complications of fixed orthodontic appliances.[14,15] Baričević et al. also reported a higher occurrence of oral mucosal lesions among patients receiving orthodontic treatment.[24] These findings are consistent with the high proportion of respondents in the present study who reported poking or irritation from orthodontic appliances or wires.

Acceptance among respondents who had experienced an adverse condition reflects an evaluation based on lived experience. In contrast, responses from participants who had not experienced the condition represent hypothetical acceptance based on expectations. These two forms of acceptance are conceptually different and should not be interpreted as directly equivalent. Experiential acceptance is likely to be influenced by symptom severity, familiarity, coping strategies, and clinical management, whereas hypothetical acceptance primarily reflects expectations, uncertainty, or fear of an unfamiliar condition.

Five conditions demonstrated significant relationships with acceptance, specifically dental caries, halitosis, increased calculus formation, preauricular pain/tightness/fatigue, and poking from appliances or wires. In each of these conditions, respondents who had actually experienced the condition showed higher acceptance than those who had not. For example, respondents who experienced increased calculus formation had an acceptance rate of 91.85 %, while those who did not experience it had an acceptance rate of only 79.76 %. A similar pattern was found for poking from appliances or wires.

The significant associations observed for dental caries, halitosis, increased calculus formation, preauricular pain/tightness/fatigue, and poking from appliances or wires may reflect differences between actual and anticipated perceptions of these conditions. Respondents who had experienced these conditions may have become more familiar with their severity, duration, and manageability, whereas those without prior experience may have anticipated greater discomfort or disruption. For conditions such as increased calculus formation and poking from appliances or wires, familiarity with practical management strategies, including improved oral hygiene, professional removal, orthodontic wax, or minor chairside adjustment, may also have contributed to greater acceptance. However, the present study did not directly assess perceived severity, controllability, symptom duration, coping strategies, or the type of management received. These explanations should therefore be considered hypothesis-generating rather than causal.

Acceptance was also higher among respondents who experienced appliance or wire detachment, but the difference was not statistically significant. This may reflect the smaller between-group difference, unequal numbers of respondents across categories, or variation in unmeasured factors such as severity, duration, impact on daily activities, expectations, and individual coping ability. Because no prospective sample-size calculation was performed, the absence of statistical significance should not be interpreted as evidence of no association.

Taken together, these findings suggest that prior experience with certain adverse conditions may be associated with greater acceptance. This observation should be interpreted with caution because the study design does not permit conclusions about causality. Future research is needed to clarify whether familiarity with a condition, perceived controllability, expectations, or other psychological factors contribute to patient acceptance.

Despite these findings, orthodontists should continue to provide oral-health care and patient education to reduce the self-reported occurrence of adverse conditions during treatment and to reduce patient anxiety, which may affect satisfaction after treatment.

Several limitations of this study should be considered when interpreting the findings. Data were collected after completion of orthodontic treatment, with a mean recall interval of 11 months and a range of 7–20 months. Participants with longer recall intervals may have remembered the occurrence, severity, or duration of adverse conditions less accurately. In addition, satisfaction with the final esthetic outcome may have led some participants to evaluate previous discomfort more favorably, resulting in retrospective glorification. Conversely, particularly unpleasant experiences may have been more readily recalled. As a result, both the reported occurrence and acceptance of adverse conditions may have been affected. In addition, because this study invited all eligible patients during the study period rather than recruiting a predetermined sample size, the final sample depended on voluntary participation and may not fully represent all eligible patients. Although all eligible patients were invited, only 219 of 465 individuals completed the questionnaire, corresponding to a response rate of 47.10 %. Nonrespondents may have differed from respondents in their treatment experiences or acceptance, resulting in potential nonresponse bias. Because no prospective sample-size calculation was performed, some comparisons may have had limited statistical precision, particularly when the number of respondents who did not accept a condition was small. Therefore, nonsignificant results should not be interpreted as evidence of no association. The study was conducted at a single institution, and the findings may not be directly applicable to patients treated in different clinical settings. Another limitation is that the severity of adverse conditions was not evaluated, although severity may influence patient acceptance. In addition, dental caries and increased calculus formation were assessed using self-reported responses rather than clinical examinations. Participants may have misidentified dental caries, white spot lesions, plaque accumulation, or calculus, which may have reduced diagnostic accuracy. This limitation may partly explain why the self-reported occurrence of dental caries in the present study was lower than the prevalence reported in clinical studies.

Further studies involving patients during active orthodontic treatment may provide a more accurate assessment of acceptance at different stages of treatment. Investigation of additional factors that may influence acceptance would also be valuable, including psychological and behavioral variables.

Conclusion

Patients reported multiple adverse conditions during fixed orthodontic treatment, and overall acceptance of these conditions was high. Acceptance differed according to occurrence status for dental caries, halitosis, increased calculus formation, preauricular pain/tightness/fatigue, and poking from appliances or wires. Because acceptance among respondents without prior experience was hypothetical rather than experience-based, these associations should be interpreted cautiously. Clinicians can provide condition-specific anticipatory guidance and practical management instructions to support patients during treatment, although prospective studies are needed to confirm their effects on acceptance.

Author contributions

Kantakawee Ruankaeo: Software, Investigation, Resources, Data Curation, Writing – Original Draft, Visualization; **Nattaporn Youravong:** Conceptualization, Methodology, Validation, Formal analysis, Writing – Review & Editing; **Supanee Suntornlohanakul:** Conceptualization, Writing – Review & Editing, Supervision, Project administration, Funding acquisition.

Ethical statement

The study was approved by the Human Research Ethics Committee of the Faculty of Dentistry, Prince of Songkla University (EC6407-049). All participants

provided informed consent prior to participation.

Disclosure statement

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AI-assisted writing declaration

The authors used Microsoft Copilot solely for language editing and grammar refinement to improve the clarity and readability of the manuscript. All AI-assisted content was reviewed, edited, and verified by the authors to ensure accuracy and integrity.

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