

Effect of psychological characteristics and malocclusion severity on compliance of removable orthodontic appliances by 10-12-year-old orthodontic patients: A research article

Navid Naseri

Islamic Azad University Shiraz Branch

Niloofar Bassagh

Islamic Azad University Shiraz Branch

Tahereh Baherimoghadam (✉ tbaheri1985@gmail.com)

Islamic Azad University, Shiraz Branch <https://orcid.org/0000-0001-7046-4239>

Zahra Hashemi

Yasuj University of Medical Sciences

Elmira Bassagh

Shiraz University of Medical Sciences

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Abstract

Background : Treatment compliance plays fundamental roles in achieving the best results in orthodontic treatment. Some psychological characteristics such as general self-efficacy (GSE) are correlated with the level of tolerance of individuals. This study aimed to assess the correlation of psychological characteristics such as GSE and level of malocclusion with compliance of removable orthodontic appliances.

Methods : The Index of Orthodontic Treatment Need (IOTN) of 50 patients between 10-12 years who required removable orthodontic appliances was determined prior to the onset of treatment. They were also requested to fill out the GSE scale (GSES). The removable orthodontic appliance compliance questionnaire was also filled out by patients at 1 (T1), 3 (T2), and 6 (T3) months after the delivery of the removable orthodontic appliance.

Results : The GSES score had significant correlations with the total score of the compliance questionnaire, and subscale score of satisfaction with the appliance during eating and oral hygiene practice, duration of usage of the appliance, and interest in using it ($P < 0.05$). The IOTN had no significant correlation with the compliance questionnaire.

Conclusions: The level of compliance of removal orthodontic appliances by patients can be predicted using the GSES. The IOTN is not efficient for prediction of the compliance level of removal orthodontic appliances by patients.

Background

Occlusion in dentistry refers to the relationship of the maxillary and mandibular teeth when they come into contact with each other. About two-thirds of the world's population have abnormal occlusion. Thus, malocclusion is a very common anomaly.¹

Creation of a beautiful smile is an important goal in orthodontic treatment because optimal esthetics is the main reason for most patients seeking orthodontic treatment.^{2,3} The Index of Orthodontic Treatment Need (IOTN) is an objective tool for measurement of the degree and severity of malocclusion that also evaluates dental esthetics. This index is a beneficial tool that aids clinicians in treatment planning and correction of dental problems such as unaesthetic appearance of the teeth.⁴

Removable orthodontic appliances are commonly used for correction of jaw position and relations, correction of jaw-size discrepancies and simple orthodontic tooth movements due to their low cost and optimal efficacy for early preventive or therapeutic orthodontic procedures in children.⁵ Removable appliances mainly include functional appliances and plates. Removable orthodontic appliances are also used in orthodontic maintenance phase after completion of fixed orthodontic treatment.⁶ However, one major drawback of removable appliances is the necessity of their use for a sufficiently long period of time on a daily basis, which leads to complications such as unfavorable feeling of presence of a foreign

object in the mouth, feeling tightness in the mouth, soft tissue traction, pressure on the mucosa, tongue displacement, and dental pain, which can all compromise patient cooperation and compliance of the appliance, and consequently treatment compliance.⁷⁻⁹ These problems can also impair the correct speech, increase salivation, and cause embarrassment for the patients.^{10,11} Moreover, impaired speech and visibility of the appliance can negatively affect the self-confidence of patients in social encounters.^{12,13}

Patient cooperation, compliance and motivation play fundamental roles in the outcome of orthodontic treatment. Absence of any of these parameters can compromise the treatment success, prolong the treatment course, and lead to dissatisfaction of orthodontist and patient.¹⁴ Evidence shows that compliance of orthodontic appliance, compliance with its use and tolerating the associated hardship and complications by the patient depend on the severity of malocclusion for the correction of which, the patient has sought orthodontic treatment.²

Designing a simple system for prediction of the compliance of removable orthodontic appliance by patients prior to the treatment onset can be helpful because patients do not usually comply with the recommended daily usage of the appliance and often exaggerate when reporting the duration of use.^{15,16} Exploring the psychological and personal characteristics of patients is a practical method for prediction of their willingness and level of motivation to undergo orthodontic treatment and comply with it, because a number of personal qualities affect daily decision making.¹⁴ By assessment of personality characteristics, orthodontists can predict the patients' reaction and compliance with different treatment plans.¹⁴ Studies on the correlation of personality traits with the level of compliance of orthodontic treatment are limited. The available previous studies on this topic showed that personal attitude towards oral health was an important motivation to seek orthodontic treatment and could affect patients' tolerance and compliance.^{17,18} The main objective of this study was to predict the level of cooperation of Iranian children undergoing orthodontic treatment by assessing their General Self-Efficacy (GSE) as a psychological characteristic and the IOTN.

Methods

This study evaluated 60 children between 10 to 12 years presenting to a private orthodontic office in November and December 2018, seeking orthodontic treatment. G* power statistical power analysis program 3.1.1 was applied to determine sample size.¹⁹ A sample size of 50 was determined by considering a power of 0.85 and effect size of $P = 0.23$ for a two-tailed Spearman correlation test ($p < 0.05$). Sample size was increased to 60 to protect from possible dropping.

The selected patients met the following inclusion criteria:

(I) The treatment plan of patients included a removable orthodontic appliance with a midline screw along with a labial bow and Adams or Delta clasps on posterior teeth

- (II) No history of orthodontic treatment
- (III) Absence of maxillofacial syndromes such as cleft lip or palate, etc.
- (IV) Absence of mental disorders

Four questioners were used in this study: Generalized Self-Efficacy Scale (GSES), Index of Orthodontic Treatment Need-Dental Health Component (IOTN-DHC) and Aesthetics Component (IOTN-AC), and compliance of orthodontic appliance questionnaire. Prior to the treatment onset, the patients filled out GSES and IOTN-AC; and IOTN-DHC were determined for each patient by researcher.

After delivery of the removable orthodontic appliance with a midline screw, labial bow, and Adams or Delta clasps on posterior teeth, the first follow-up session was scheduled at 1 month (T1). At the first follow-up, the patients filled out compliance questionnaire for the first time. The compliance questionnaire was filled out again by the patients 3 (T2), and 6 (T3) months after delivery. Written informed consent was obtained from the parents prior to the study. However, the questionnaires were filled out by patients in absence of parents. The researcher explained the questions in the questionnaires to the patients and instructed them on how to fill it out.

Study variables

1. IOTN:

The IOTN is an efficient tool for assessment of the need for orthodontic treatment in a community, and has several applications in programming, allocation of resources, and improvement of treatment standards. This index has two components: IOTN-DHC and IOTN-AC.²⁰

In IOTN-DHC, the severity of malocclusion is divided into five grades. Higher grades indicate greater need for orthodontic treatment. Accordingly, the orthodontic treatment need can be divided into the following groups:

Group 1 (no need or slight need for orthodontic treatment): Grades 1 and 2

Group 2 (moderate need for orthodontic treatment): Grade 3

Group 3 (severe need for orthodontic treatment): Grade 4

Group 4 (very severe need for orthodontic treatment): Grade 5

The IOTN-AC is used to assess the patient satisfaction with the appearance of the teeth such that 10 images of different dentitions are shown to patients, and they are requested to pick the image with the

highest resemblance to their dental status. Selection of images is interpreted as follows:

Images 1–4: Complete satisfaction or slight dissatisfaction with the appearance of the teeth

Images 5–7: Moderate satisfaction with the appearance of the teeth

Images 8–10: Complete dissatisfaction with the appearance of the teeth

2. GSES:

This questionnaire evaluates the confidence of individuals in their capabilities to succeed in different situations. It was first designed by SCHWARZER and JERUSALEM in 1995, and indicates the reliable correlation between the level of healthy behaviors and formation of health-related habits in an individual.¹⁶ This questionnaire has 10 items, which are scored according to a 4-point Likert scale. Each item has four answer choices, and the respondent should choose the statement that best describes his/her condition:

- (I) Totally opposite to me (score 1)
- (II) Slightly resembles me (score 2)
- (III) Highly resembles me (score 3)
- (IV) Perfectly resembles me (score 4)

This questionnaire is a single-component questionnaire and the scores of the items are summed. The total score can range from 10 to 40. Higher total scores indicate higher GSE of the individual. In this study, the Persian version of GSES was used. The validity and reliability of the Persian of this questionnaire have been previously confirmed.²¹

Compliance of orthodontic appliance questionnaire:

This questionnaire was used to assess the compliance of removable orthodontic appliance by patients. This questionnaire has 10 incomplete statements, which need to be completed by the patient's choice. The available answer choices were scored using a 6-point Likert scale. In order to enhance the understanding of children from each answer choice, each answer choice had a matching facial expression over it (Table 1). Scores 5 to 0 were allocated to the answer choices from left to right. In other words, a higher score indicated higher compliance and satisfaction with the respective item. The total score of this questionnaire ranged from 0 to 55. A higher total score indicated that the patient better accepted the problems of using the removable orthodontic appliance and had higher motivation to continue the treatment.

Table 1
Compliance of orthodontic appliance scale.

Questions	Score 5	Score 4	Score 3	Score 2	Score 1	Score 0
1. Speaking during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
2. Swallowing saliva during using plaque.	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
3. Oral and dental appearance during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
4. Facial appearance during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
5. Oral hygiene during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
6. Doing daily activities during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						
7. Sleeping during using plaque	Doesn't hurt at all	Hurts a bit	Hurts a little	Hurts	Hurts too much	Completely hurts
						

Questions	Score 5	Score 4	Score 3	Score 2	Score 1	Score 0
						
8. Level of using plaque	Too much	much	often	few	little	Not all
						
9. Level of liking plaque	Too much	much	often	few	little	Not all
						
10. Level of liking to complete orthodontic treatment	Too much	much	often	few	little	Not all
						

Statistical analysis:

Data were analyzed using SPSS version 25 via descriptive and inferential statistics. In descriptive statistics, the frequency distribution of the IOTN-AC and IOTN-DHC scores was calculated for the participants. In inferential statistics, the reliability of the compliance questionnaire was evaluated using the Cronbach's alpha test. According to the result of one-sample Kolmogorov-Smirnov test for normality assessment of variables, Friedman Two-way analysis of variance (ANOVA) and Wilcoxon signed rank test were applied to analyze the change in compliance questionnaire individual and total scores at T1, T2, and T3. The Spearman's rho was calculated to assess the correlation between the mean total and individual scores (for the 10 items) of the compliance questionnaire filled out at T1, T2, T3 with the IOTN-DHC, IOTN-AC, and the GSES scores.

Results

Of the 58 patients assessed for eligibility, 5 (8.6%) patients filled questionnaire incompletely and 3 (5.2%) didn't adhere to follow up time; therefore, 8 patients were excluded. From 50 patients who completed study, 21 (42%) were boy (11 ± 1.23 years old) and 29 (58%) were girl (10 ± 0.57 years old).

The Cronbach's alpha for the compliance questionnaire was found to be 0.82, which indicated good internal consistency of this questionnaire (Table 2). Assessment of the normality of variables revealed that data were not normally distributed. Thus, data were analyzed using the non-parametric tests. Comparison of the total and individual scores of the compliance questionnaire at T1, T2, and T3 revealed no significant change ($P > 0.05$, Table 3). The IOTN-DHC and IOTN-AC scores had no significant correlation with the mean compliance questionnaire score of T1, T2, and T3 (Table 4). However, the GSES

score had significant correlations with the individual scores of questions 5, 8 and 9, and the total score of the compliance questionnaire ($P < 0.05$, Table 5).

Table 2
Reliability of the compliance of orthodontic appliance.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.820	.823	10

Table 3
Changes of the mean scores of the compliance of orthodontic appliance scale within 6 months.

	Mean scores of orthodontic appliance compliance			<i>P-value</i>
	T1	T2	T3	
1. Speaking during using plaque	11.50	12.50	12.04	0.730
2. Swallowing saliva during using plaque	6.08	7.79	8.14	0.512
3. Oral and dental appearance during using plaque	8.78	8.14	8.13	0.554
4. Facial appearance during using plaque	9.79	9.32	10.02	0.419
5. Oral hygiene during using plaque	9.45	10.75	9.45	0.712
6. Doing daily activities during using plaque	9.68	7.75	8.14	0.138
7. Sleeping during using plaque	7.25	4.50	5.14	0.329
8. Level of using plaque	14.90	12.00	13.01	0.502
9. Level of liking plaque	14.38	15.77	16.43	0.781
10. Level of liking to complete orthodontic treatment	11.73	12.35	12.15	0.654
Total	22.95	18.67	19.47	0.432

Table 4

The Correlation between IOTN components and compliance of orthodontic appliance.

	Correlation	IOTN_LAC	IOTN_DHC
1. Speaking during using plaque	Correlation Coefficient	-0.001	0.109
	Sig. (2-tailed)	0.994	0.452
2. Swallowing saliva during using plaque	Correlation Coefficient	0.048	0.139
	Sig. (2-tailed)	0.740	0.336
3. Oral and dental appearance during using plaque	Correlation Coefficient	-0.180	0.003
	Sig. (2-tailed)	0.210	0.985
4. Facial appearance during using plaque	Correlation Coefficient	0.124	-0.180
	Sig. (2-tailed)	0.393	0.210
5. Oral hygiene during using plaque	Correlation Coefficient	-0.039	0.116
	Sig. (2-tailed)	0.790	0.422
6. Doing daily activities during using plaque	Correlation Coefficient	-0.098	-0.064
	Sig. (2-tailed)	0.498	0.661
7. Sleeping during using plaque	Correlation Coefficient	0.063	-0.052
	Sig. (2-tailed)	0.662	0.720
8. Level of using plaque	Correlation Coefficient	-0.017	0.082
	Sig. (2-tailed)	0.905	0.573
9. Level of liking plaque	Correlation Coefficient	0.176	-0.101
	Sig. (2-tailed)	0.221	0.487
10. Level of liking to complete orthodontic treatment	Correlation Coefficient	0.132	-0.013
	Sig. (2-tailed)	0.360	0.929
Total Score	Correlation Coefficient	0.057	0.033

	Correlation	IOTN_LAC	IOTN_DHC
	Sig. (2-tailed)	0.694	0.819

Table 5
The correlation between GSES and compliance of orthodontic appliance.

	Spearman's Correlation	Total score of GSES
1. Speaking during using plaque	Correlation Coefficient	0.079
	Sig. (2-tailed)	0.587
2. Swallowing saliva during using plaque	Correlation Coefficient	-0.081
	Sig. (2-tailed)	0.576
3. Oral and dental appearance during using plaque	Correlation Coefficient	0.134
	Sig. (2-tailed)	0.352
4. Facial appearance during using plaque	Correlation Coefficient	0.162
	Sig. (2-tailed)	0.260
5. Oral hygiene during using plaque	Correlation Coefficient	0.303
	Sig. (2-tailed)	0.032*
6. Doing daily activities during using plaque	Correlation Coefficient	0.011
	Sig. (2-tailed)	0.938
7. Sleeping during using plaque	Correlation Coefficient	0.177
	Sig. (2-tailed)	0.220
8. Level of using plaque	Correlation Coefficient	0.296
	Sig. (2-tailed)	0.037*
9. Level of liking plaque	Correlation Coefficient	0.530
	Sig. (2-tailed)	0.000*
10. Level of liking to complete orthodontic treatment	Correlation Coefficient	0.109
	Sig. (2-tailed)	0.451
Total Score	Correlation Coefficient	0.486
	Sig. (2-tailed)	0.000*

Discussion

The removable orthodontic appliance compliance questionnaire evaluates the patients' level of cooperation and compliance of removable orthodontic appliance. This questionnaire included 10 questions regarding the use of removable orthodontic appliance. The patient could choose the most appropriate response choice based on his/her experiences of discomfort. Assessment of the reliability of this questionnaire was measured with Cronbach's Alpha and the result showed good reliability. Accepted rule of thumb showed that α of 0.8 or higher indicates good reliability.

In order to assess the patients' compliance of removable orthodontic appliances over time, the questionnaire was filled out again at 3 and 6 months after delivery. Comparison of the results at T1, T2, and T3 revealed that the total and individual scores did not significantly change. In other words, the compliance of patients did not significantly change during 5 months ($P > 0.1$). This finding was in agreement with the results of Serogl HG et al, who found no significant change in the frequency of patient complaints regarding orthodontic appliance after a long treatment course.²²

The baseline malocclusion severity of patient is another parameter, which is believed to affect the compliance of orthodontic appliance by patients. We applied IOTN-DHC and IOTN-AC to determine malocclusion severity. This index is highly popular due to being quick, and simplicity of use, and is commonly employed in many European and Asian countries with orthodontic treatment insurance.^{20, 23} Sarul M et al, and Proffit W et al found a significant correlation between the severity of malocclusion and a compliance and cooperation of patients.^{4, 24} Nonetheless, the current results revealed no significant correlation between the total and individual scores of the compliance questionnaire and severity of malocclusion (IOTN-AC and IOTN-DHC) ($P > 0.2$). Evidence shows that patients with severe malocclusion and scores 4 or 5 of IOTN, psychological status is significantly affected by malocclusion.^{25, 26} No significant correlation between compliance questionnaire and severity of malocclusion can be due to low to moderate need for orthodontic treatment among our study population.

The patients' psychological status is another parameter than can affect the compliance of orthodontic appliance. GSE is a concept derived from the theory of social learning and plays an important role in formation of healthy behaviors and patient compliance to treatment.^{16, 27} In this study, the standard GSES was used, which has shown optimal validity and reliability in the Iranian population.²¹ Some previous studies showed that GSE of patients had a significant correlation with the use of removable appliance or number of complaints about it.^{16, 28} The current results revealed significant associations between the GSES score and the total score ($r = 0.486$) and three individual scores of the compliance questionnaire, regarding interest in using the appliance ($r = 0.530$), oral hygiene practice in presence of the appliance ($r = 0.303$), and duration of usage of the appliance ($r = 0.296$; $P < 0.05$).

Several other studies used different psychological tests and tried to assess the correlation between the compliance of orthodontic appliance and cooperation of patients during the course of treatment. Serogl HG et al, and Cooper-Kazaz R et al. found a significant correlation between some psychological test results and compliance of orthodontic appliance by patients, which was in agreement with our findings.^{22, 29} Nonetheless, several studies reported both positive and inverse correlations between some

personality traits and compliance of orthodontic appliances, while some others found no such correlations at all.^{14,30-32}

According to the current findings, use of psychological tests for prediction of patient compliance can be helpful when clinicians cannot decide whether to start an early treatment for malocclusion or postpone the treatment to older ages and replace it with camouflage treatment or orthognathic surgery. The mood characteristics of patients can compromise their compliance to orthodontic treatment. Also, poor financial status can prevent the conduction of all or part of orthodontic treatment. Thus, for treatment of malocclusion in children, psychological assessment and prediction of patient compliance to treatment and use of removable orthodontic appliance can result in more affordable and efficient treatment plans by use of public resources or insurance system.

Conclusion

The GSES is suitable for prediction of the compliance of removable orthodontic appliance by 10-12-year-old orthodontic patients; while the severity of malocclusion determined by using the IOTN prior to treatment cannot serve as a good indicator for this purpose. Also, the compliance level of orthodontic appliance by patients in our study did not significantly change after 6 month of use.

Abbreviations

IOTN:The Index of Orthodontic Treatment Need; GSE:General Self-Efficacy; GSES:Generalized Self-Efficacy Scale; IOTN-DHC:Index of Orthodontic Treatment Need-Dental Health Component; IOTN-AC:Index of Orthodontic Treatment Need-Aesthetics Component; ANOVA:Analysis of variance.

Declarations

• Ethics approval and consent to participate:

Ethical approval to conduct the study was granted by the Medical Ethics Committee, Shiraz branch, Islamic Azad university, Iran (No: 16310201972005). Informed consents were obtained from all study participants included in the study. Participation was on a voluntary basis and no remuneration was involved.

• Consent for publication:

Not applicable

• Availability of data and material:

The datasets used and/or analyzed during the present study are available from the corresponding author.

• Competing interests:

The authors declare that they have no competing interests.

- Funding:

No funding was provided for this study.

- Authors' contributions:

NN and TBM contributed in the design of the study, wrote the first draft of the manuscript, revised the manuscript, participated in data interpretation, and gained permission from the Medical Ethics Committee, Shiraz branch, Islamic Azad university, Iran. NB and EB participated in acquisition of data and revision of the manuscript. ZH participated in statistical analyses and interpretation, and provided critical comments. All authors read and approved the final manuscript.

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