Original Article

Comparison of personality traits, attitude toward orthodontic treatment, and pain perception and experience before and after orthodontic treatment

Elham S. Abu Alhaija[a]; Mona A. Abu Nabaa[b]; Emad F. Al Maaitah[c]; Mahmoud K. Al-Omairi[d]

ABSTRACT

Objective: To compare personality traits, attitude toward orthodontic treatment, and pain perception and experience before and after orthodontic treatment.

Materials and Methods: One hundred subjects (50 male and 50 female) were included in this study. The mean (SD) age was 17.5 (2.05) years at T1 and 19.15 (2.32) years at T2. The instruments for data collection were questionnaires that included assessment of patients' personality traits, attitudes toward orthodontic treatment, and pain perception/experience. Subjects completed the questionnaires at two different times: before orthodontic treatment (T1) and after fixed orthodontic treatment (T2). Subjects were treated by fixed orthodontic appliances for an average (SD) period of 18.64 (0.35) months. Paired sample *t*-test and chi-square test were used to detect any differences.

Results: Significant changes in personality traits were detected after orthodontic treatment irrespective of gender. Neuroticism, openness, agreeableness, and conscientiousness scores were improved ($P < .001$). A positive attitude toward orthodontic treatment was reported at T1 (4.31 [$\pm$1.26]) and improved at T2 (3.98 [$\pm$1.16]) irrespective of gender ($P < .05$). The average (SD) expected pain score (T1) was 4.73 (1.88) and the average (SD) experienced pain score (T2) was 4.63 (1.58). Significant difference in the expected and experienced pain scores was not detected ($P = .11$).

Conclusions: Personality traits and attitude toward orthodontic treatment improved after orthodontic treatment. Reported actual pain experience during orthodontic treatment was similar to that expected before treatment. (*Angle Orthod.* 2015;85:474–479.)

KEY WORDS: Personality; Attitude; Pain

INTRODUCTION

The interaction between malocclusion and personality is complex because of the various effects of the malocclusions and appearance on psychological well-being.[1] Personality traits like extroversion, anxiety, calmness, and warmth have been proved to have well-defined effects on patients' opinion regarding dentofacial esthetics.[2]

It has been suggested that personality traits were improved after orthodontic treatment. Flanary et al.[3] conducted a study on 61 orthognathic surgery patients and found that there was major improvement of personality disturbances: general maladjustment, psychosis, neurosis, personality disorder, and personality integration. Varela and García-Camba[4] studied the impact of orthodontic treatment on the psychological profile of adult patients. They observed significant improvement in emotional stability, maturity, ability to cope with reality, higher scrupulous attitudes, conscience and persistence, and an increase in inhibition and reserve after orthodontic treatment. Cunningham et al.[5] reported that patients may experience a rise in self-confidence and social skills following orthodontic treatment.

Efficient clinical management of patients seeking orthodontic treatment requires patients' motivation and

[a] Professor, Preventive Dentistry Department, Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan.

[b] Master student, Preventive Dentistry Department, Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan.

[c] Assistant Professor, Preventive Dentistry Department, Faculty of Dentistry, Jordan University of Science and Technology, Irbid, Jordan.

[d] Associate Professor, Department of Prosthodontics, Faculty of Dentistry, University of Jordan, Amman, Jordan.

Corresponding author: Professor Elham S. J. Abu Alhaija, Preventive Dentistry Department, Faculty of Dentistry, Jordan University of Science and Technology, PO Box 3030, Irbid, Jordan
(e-mail: elham@just.edu.jo)

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cooperation, which may be affected by the attitude toward orthodontic treatment.[6] Bos et al.[7] evaluated treated and untreated subjects' attitudes toward orthodontic treatment. They reported that previously treated subjects had a more positive attitude toward orthodontic treatment than untreated subjects.

Recent studies have highlighted the personality characteristics as intrinsic factors that affect patients' motivation for orthodontic treatment.[8,9] Hansen et al.[10] showed that personality traits had a modest but significant correlation to potential willingness to undergo various orthodontic treatments. They reported that agreeableness proved to be the trait most often associated with willingness to undergo different orthodontic treatments. On the other hand, Bos et al.[9] and Amado and Sierra[11] reported that personality traits of adolescents do not solely predict cooperation during treatment.

Gender can affect the attitude toward orthodontic treatment.[12] Abu Alhaija et al.[13] found that female patients are more willing to undergo orthodontic treatment. It has been stated that gender differences were present if there was no previous orthodontic treatment.[7] However, few differences between male and female patients were reported if there was previous experience with treatment.[7] Studies carried out to determine the experience of pain during orthodontic treatment rated pain as a key limitation to orthodontic therapy and a major reason for terminating the treatment.[14] A strong correlation between a patient's attitude toward orthodontic treatment and discomfort felt after appliance insertion was suggested.[15] Bergius et al.[16] found that patients with prolonged pain reactions were less motivated for orthodontic treatment compared with those who did not report pain after 1 week.

Abu Alhaija et al.[17] investigated the relationship between personality traits and patients' attitude toward orthodontic treatment and perception of pain. They concluded that attitude toward orthodontic treatment and pain perception/experience during orthodontic treatment was not affected by personality traits. Less pain throughout orthodontic treatment is associated with a more positive attitude toward the outcome of orthodontic treatment.

To date, no studies have investigated the effect of orthodontic treatment on personality characteristics, individual's general attitude toward orthodontic treatment, and pain perception/experience before and after fixed orthodontic treatment. As patients' personality, attitude toward orthodontic treatment, and their pain perception/experience may change during the course of orthodontic treatment, this study was carried out.

The aims of the study were to: (1) compare personality traits for subjects before (T1) and after (T2) orthodontic treatment; (2) compare subject's attitude toward orthodontic treatment before (T1) and after (T2) orthodontic treatment; and (3) compare subject's expectation of pain before (T1) orthodontic treatment and actual pain experience during (T2) orthodontic treatment.

MATERIALS AND METHODS

Ethical approval for the study was obtained from the Institutional Research Board at the Jordan University of Science and Technology. One hundred subjects (50 male and 50 female) were included in this study. Sample size calculation was performed.[18] When the average differences were set at 0.3, alpha at 0.05 and beta at 0.8, the minimum sample size was 90 subjects. The mean (SD) ages of the included subjects were 17.5 (2.05) years at T1 and 19.15 (2.32) years at T2. Subjects were selected from Jordan University of Science and Technology consultation clinics and were treated by fixed orthodontic appliances by one orthodontist for an average (SD) period of 18.64 (0.35) months.

The instruments for data collection were questionnaires that were developed for the purpose of a similar study.[19] Subjects completed the questionnaire at two different times: before orthodontic treatment (T1) and after fixed orthodontic treatment (T2). At T1, 150 subjects completed the questionnaire, while only 100 of these subjects completed it at T2. Only those who completed the questionnaires at T1 and T2 were included in the analysis.

A brief explanation about the scope of the study and clarification of some of the questions included in the questionnaires and how to score them were given to all subjects. Patients were encouraged to ask for assistance if they encountered any difficulty in understanding or completing the questionnaires.

Assessment of patients' personality profiles and traits was carried out using the Neuroticism, Extraversion, and Openness Five Factor Inventory (NEO-FFI) test (Appendix 1).[20] This test provides a comprehensive assessment of personality using five major domains, namely neuroticism, extraversion, openness, agreeableness, and conscientiousness. The test consists of 60 items, 12 for each domain, and the subjects filled in their response to the statement by choosing one of five answers relevant to each question (strongly agree, agree, neutral, disagree, and strongly disagree). Then, each personality domain is classified based on total domain score as very high, high, average, low, and very low. For convenience in performing statistical analysis, very high and high categories were considered high, while very low and low categories were considered low. The NEO-FFI is a brief but comprehensive test

of one's personality. Although it is brief, it is highly valid, reliable, and accurate in measuring personality traits.[20] Also, it is easy for the subject to answer, it is easy to score and easy to interpret, and finally, it is well documented in the literature.[21] In addition, it has been previously used to measure personality traits for patients with postorthodontic treatment satisfaction.[19]

Pain expectation at T1 and actual experience at T2 for the subjects was assessed using a visual analog scale (VAS) based on a line marked at 10-mm intervals whose ends are anchored and defined with verbal descriptors such as "extremely likely" and "extremely unlikely." A Likert response format was used for all questions. This questionnaire consisted of nine items regarding pain (Appendix 2). Each patient was asked to place a mark on the line nearest to his/her expectation or experience. The nine scores were averaged to get one score referred to as an average pain expectation/experience score. On the VAS line, the lowest scores indicated less pain experienced/expected from orthodontic treatment and the highest scores indicated more pain experienced/expected from orthodontic treatment. The VAS is widely used for measuring pain, and it has been described by other investigators as being sensitive, reliable, and easy. It also has certain advantages over verbal scales, and even small children manage to complete it very well.[22]

Patients' attitude toward orthodontic treatment at T1 and T2 was assessed using (VAS marked at 10-mm intervals. A questionnaire consisting of 12 items, mainly about attitude toward orthodontic treatment, was given to each subject (Appendix 3). Subjects were asked to answer questions by placing a mark on the line nearest to their attitude toward the treatment. On the VAS line, the lowest scores indicate a more positive attitude toward orthodontic treatment and the highest scores indicate a less positive attitude toward orthodontic treatment.

In this study, changes in the average pain and attitude scores will be of relevance rather than the value of the score. After subjects completed the questionnaires, they were checked to see if all of the items were scored, and the subject was asked to complete any missing items.

Method Error

Ten subjects answered the questionnaire twice within a 2-week interval. Reliability was carried out on all questions using Cronbach alpha.[23] Cronbach alpha ranged from 0.85–0.92, indicating good internal consistency.

Statistical Analysis

Data analysis was carried out using the Statistical Package for the Social Sciences computer software for windows (SPSS, version 20, Chicago, Ill). Comparison between T1 and T2 measurements was carried out using paired sample *t*-test. Independent *t*-test was used to detect gender differences. Chi-square test was used to detect any differences in personality traits in and between T1 and T2. Significant probability levels were set at $P < .05$.

RESULTS

Personality Traits

Distribution of personality traits at T1 and T2 are shown in Table 1. The means, standard deviations, differences between the means, and *P* values for personality traits at T1 and T2 for male, female, and all subjects are shown in Table 2.

Gender differences were detected at T1 in neuroticism ($P < .01$) and agreeableness ($P < .05$) scores. At T2, gender differences in personality traits were not detected.

Neuroticism scores were reduced after orthodontic treatment. A mean difference of 0.39 was significant at $P < .001$. On the other hand, openness, agreeableness, and conscientiousness scores increased ($P < .001$) after treatment.

Attitude Toward Orthodontic Treatment

The means, standard deviations, differences between the means, standard error of the mean (SEM), and *P* values for average attitude and pain scores at T1 and T2 are shown in Table 3. Gender differences were not detected in average attitude scores at T1 ($P = .183$) and T2 ($P = 1.000$).

At T1, a positive attitude toward orthodontic treatment was reported. The average (SD) attitude score toward orthodontic treatment was 4.31 (1.26): 4.48 (1.49) and 4.14 (0.96) for male and female subjects, respectively. At T2, the average (SD) attitude score was 3.98 (1.16): 3.98 (1.35) and 3.98 (0.96) for male and female subjects, respectively. The average positive attitude toward orthodontic treatment improved after orthodontic treatment. Significant improvements were detected in male subjects and in the total sample ($P < .05$).

Average Pain Scores of Orthodontic Treatment

The means, standard deviations, differences between the means, standard error of the mean (SEM), and *P* values for average pain scores at T1 and T2 are shown in Table 3. Gender differences were not detected in average pain score at T1 ($P = .87$) and T2 ($P = .32$).

At T1 the average (SD) expected pain score was 4.73 (1.88): 4.70 (2.16) and 4.76 (1.57) for male and female subjects, respectively. At T2, the average (SD) experienced pain score was 4.63 (1.58): 4.47 (1.66)

Table 1. Distribution and Frequency of Personality Traits Among Study Population[a]

		T1			T2		
Personality Trait	Score	Male N = 50	Female N = 50	Total N = 100	Male N = 50	Female N = 50	Total N = 100
Neuroticism	High	23	11	34	8	11	19
	Average	26	30	56	22	25	47
	Low	1	9	10	20	14	34
P Value		.004**			.422		
Extroversion	High	18	23	41	21	25	46
	Average	26	20	46	20	19	39
	Low	6	7	13	9	6	15
P Value		.480			.615		
Openness	High	2	5	7	4	9	13
	Average	20	20	40	30	29	59
	Low	28	25	53	16	12	28
P Value		.483			.285		
Agreeableness	High	3	1	4	4	7	11
	Average	4	13	17	11	14	25
	Low	43	36	79	35	29	64
P Value		.041*			.419		
Conscientiousness	High	10	12	22	20	20	40
	Average	26	25	51	22	28	50
	Low	14	13	27	8	2	10
P Value		.888			.115		

[a] T1 indicates before treatment; T2, after treatment.
* $P < .05$; ** $P < .01$.

and 4.78 (1.50) for male and female subjects, respectively. Significant difference was not detected.

DISCUSSION

To our knowledge, no studies have investigated the effect of orthodontic treatment on personality characteristics, individual's general attitude toward orthodontic treatment, and pain perception/experience. This study was carried out because the personality of patients, their attitudes toward orthodontic treatment, and their pain perception/experience may change during the course of orthodontic treatment.

The use of different questionnaires to assess the effects of personality traits on orthodontic patients in previous studies makes comparison with other studies more difficult.

In this study, a significant improvement in personality traits (neuroticism, openness, agreeableness, conscientiousness) was identified after orthodontic treatment. These findings were in agreement with those of Varela and García-Camba[4] who reported significant improvement in emotional stability after orthodontic treatment. Also, Cunningham et al.[5] reported that patients may experience a rise in self-confidence and social skills following orthodontic treatment. The improvement of the personality scores may be linked to the decline in dental anxiety levels when the patients become familiar with their orthodontist and get used to the orthodontic appliance.[24]

In this study, the average attitude toward orthodontic treatment improved after patients with a positive attitude toward orthodontic treatment received their orthodontic treatment. This result was in agreement with that of Bos et al.[7] who reported that positive attitude was increased in treated patients compared to untreated ones. These findings differed, however, from

Table 2. The Means, Standard Deviations (SD), Differences Between the Means, Standard Error of the Means (SE), and *P* Values for Personality Traits at T1 and T2[a]

	Male			Female			Total		
Personality Trait	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)
Neuroticism	2.44 (0.54)	1.76 (0.72)	0.10 (0.10)***	2.04 (0.63)	1.94 (0.71)	0.10 (0.10)	2.24 (0.62)	1.85 (0.72)	0.39 (0.07)***
Extroversion	2.24 (0.65)	2.24 (0.74)	0.04 (0.09)	2.32 (0.71)	2.38 (0.70)	−0.06 (0.10)	2.28 (0.68)	2.31 (0.72)	−0.03 (0.06)
Openness	1.48 (0.58)	1.76 (0.59)	−0.02 (0.09)**	1.60 (0.67)	1.94 (0.65)	−0.34 (0.09)***	1.54 (0.62)	1.85 (0.63)	−0.31 (0.07)***
Agreeableness	1.20 (0.53)	1.38 (0.64)	0.00 (0.07)*	1.30 (0.50)	1.56 (0.73)	−0.26 (0.09)*	1.25 (0.52)	1.47 (0.69)	−0.22 (0.06)***
Conscientiousness	1.92 (0.69)	2.24 (0.72)	0.04 (0.10)***	1.98 (0.71)	2.36 (0.56)	−0.38 (0.10)***	1.95 (0.70)	2.30 (0.64)	−0.35 (0.07)***

[a] T1 indicates before treatment; T2, after treatment.
* $P < .05$; ** $P < .01$; *** $P < .001$.

Table 3. The Means, Standard Deviations (SD), Differences Between the Means, Standard Error of the Means (SE), and *P* Values for Average Attitude and Pain Scores at T1 and T2[a]

	Male			Female			Total		
	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)	T1 Mean (SD)	T2 Mean (SD)	Mean Diff (SEM)
Attitude scores	4.48 (1.49)	3.98 (1.35)	0.49 (0.21)*	4.14 (0.96)	3.98 (0.96)	0.16 (0.17)	4.31 (1.26)	3.98 (1.16)	(0.32)*
Pain scores	4.70 (2.16)	4.47 (1.66)	0.23 (0.33)	4.76 (1.57)	4.78 (1.50)	0.02 (0.34)	4.73 (1.88)	4.63 (1.58)	(0.11)

[a] T1 indicates before treatment; T2, after treatment.
* $P < .05$.

a recent study conducted by Abu Alhaija et al.,[17] which found that treated and untreated patients had similar attitudes toward orthodontic treatment and an earlier study of Lagerström et al.[25] that reported no significant differences between treated and untreated individuals. The difference between the result of the current research and that reported by Abu Alhaija et al.[17] is that the current study is longitudinal and the previous one is cross-sectional in which two different groups (treated and untreated) were compared; in this study, the same subjects were followed up after treatment. The improved positive attitude of the patients after orthodontic treatment may be explained by the knowledge and information gained from their own orthodontic experience. In the present study, the average attitude scores for male subjects were similar to female subjects. This was in agreement with other studies that showed that gender did not affect the attitude toward orthodontic treatment.[7,11,17] On the other hand, others reported that gender difference correlates with the general attitude toward orthodontic treatment.[13] Different social and racial backgrounds may explain the contradiction. In this study, the average subject's actual pain experience was not different from that expected. This result was in agreement with that of Firestone et al.,[26] who reported that the experienced pain did not differ statistically from the expected pain in the studied subjects. They explained their results as reflecting a patient's general measure of anxiety. Conversely, Kafle and Rajbhandari[27] found that the level of anticipated pain before orthodontic treatment is higher than the real pain experienced after orthodontic procedures.

The average expected pain scores for male and female subjects were comparable to their average experienced pain scores. No significant differences were detected. This was in agreement with other researchers.[28,29] However, Abu Alhaija et al.[17] found that female patients reported more sensitivity to pain. Also, Krishnan[30] found that female patients reported experiencing more pain than male patients. The difference between the results of the current study and those reported earlier by Abu Alhaija et al.[17] can be explained in that the current study is longitudinal and the previous one was cross-sectional.

The limitation of this study includes the short follow-up period after treatment. This period may not allow detection of personality changes that may happen due to orthodontic treatment. Future research that will explore any change in personality traits, attitude toward orthodontic treatment, and pain perception/experience at least 1 year after orthodontic treatment is completed is recommended.

CONCLUSIONS

- Personality traits (neuroticism, openness, agreeableness, conscientiousness) improved after orthodontic treatment.
- Attitude toward orthodontic treatment improved after orthodontic treatment.
- The pain subjects experienced during orthodontic treatment was similar to that expected before orthodontic treatment.
- Attitude toward orthodontic treatment and pain expected/experienced during orthodontic treatment were not affected by gender.

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REFERENCES

1. Birkeland K, Bøe OE, Wisth PJ. Relationship between occlusion and satisfaction with dental appearance in orthodontically treated and untreated groups. A longitudinal study. *Eur J Orthod*. 2000;22:509–518.
2. Dong H, Bogg L, Rehnberg C, Diwan V. Health financing policies. Providers' opinions and prescribing behavior in rural China. *Int J Technol Assess Health Care*. 1999;15:686–698.
3. Flanary CM, Barnwell GM, VanSickels JE, Littlefield JH, Rugh AL. Impact of orthognathic surgery on normal and abnormal personality dimensions: a 2-year follow-up study of 61 patients. *Am J Orthod Dentofacial Orthop*. 1990;98:313–322.
4. Varela M, García-Camba JE. Impact of orthodontics on the psychological profile of adult patients: a prospective study. *Am J Orthod Dentofacial Orthop*. 1995;108:142–148.
5. Cunningham SJ, Hunt NP, Feinmann C. Psychological aspects of orthognathic surgery: a review of the literature. *Int J Adult Orthodon Orthognath Surg*. 1995;10:159–172.

6. Sergl HG, Klages U, Zentner A. Functional and social discomfort during orthodontic treatment-effects on compliance and prediction of patients' adaptation by personality variables. *Eur J Orthod*. 2000;22:307–315.
7. Bos A, Hoogstraten J, Prahl-Andersen B. Attitudes towards orthodontic treatment: a comparison of treated and untreated subjects. *Eur J Orthod*. 2005;27:148–154.
8. Abrahamsson KH. *Dental Fear and Oral Health Behavior: Studies on Psychological and Psychosocial Factors* [doctoral thesis]. Gothenburg, Sweden: Faculty of Odontology, The Sahlgrenska Academy at Gothenburg University; 2003.
9. Bos A, Hoogstraten J, Prahl-Anderson B. On the use of personality characteristics in predicting compliance in orthodontic practice. *Am J Orthod Dentofacial Orthop*. 2003;123:568–570.
10. Hansen V, Liu S, Schrader S, Dean J, Stewart K. Personality traits as a potential predictor of willingness to undergo various orthodontic treatments. *Angle Orthod*. 2013;83:899–905.
11. Amado J, Sierra A. Relationship between personality traits and cooperation of adolescent orthodontic patients. *Angle Orthod*. 2008;78:688–691.
12. DiMatteo MR, McBride CA, Shugars DA, O'Neil EH. Public attitudes toward dentists: a U.S. household survey. *J Am Dent Assoc*. 1995;126:1563–1570.
13. Abu Alhaija ESJ, Al-Nimri KS, Al-Khateeb SN. Self-perception of malocclusion among north Jordanian school children. *Eur J Orthod*. 2005;27:292–295.
14. Kluemper GT, Hiser DG, Rayens MK, Jay MJ. Efficacy of a wax containing benzocaine in the relief of oral mucosal pain caused by orthodontic appliances. *Am J Orthod Dentofacial Orthop*. 2002;122:359–365.
15. Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. *Am J Orthod Dentofacial Orthop*. 1998;114: 684–691.
16. Bergius M, Broberg AG, Hakeberg M, Berggren U. Prediction of prolonged pain experiences during orthodontic treatment. *Am J Orthod Dentofacial Orthop*. 2008;133: 139.e1–e8.
17. Abu Alhaija ES, AlDaikki A, Al-Omairi MK, Al-Khateeb SN. The relationship between personality traits, pain perception and attitude toward orthodontic treatment. *Angle Orthod*. 2010;80:1141–1149.
18. Cohen JA. A coefficient of agreement for nominal scales. *Educ Psychol Measure*. 1960;20:37–46.
19. Al-Omiri MK, Abu Alhaija ES. Factors affecting patient satisfaction after orthodontic treatment. *Angle Orthod*. 2006; 76:422–431.
20. Costa PT Jr, McCrae RR. *Revised NEO Personality Inventory (NEO PI-R) and NEO Five Factor Inventory (NEO-FFI) Professional Manual*. Odessa, Fla: PAR Psychological Assessment Resources Inc; 1992.
21. Saucier G. Replicable item-cluster subcomponents in the NEO Five-Factor Inventory. *J Pers Assess*. 1998;70:263–276.
22. Bergius M, Kiliardis S, Berggren U. Pain in orthodontics: a review and discussion of the literature. *J Orofac Orthop*. 2000;61:125–137.
23. Cronbach LJ. *Essentials of Psychological Testing*. 5th ed. New York, NY: Harper Collins; 1990:123–154.
24. Yıldırım E, Karacay S. Evaluation of anxiety level changes during the first three months of orthodontic treatment, *Korean J Orthod.* 2012;42:201–206.
25. Lagerström L, Stenvik A, Espeland L, Hallgren A. Outcome of a scheme for orthodontic care: a comparison of untreated and treated 19-year-olds. *Swedish Dent J*. 2000;24:49–57.
26. Firestone AR, Scheurer PA, Burgin WB. Patients' anticipation of pain and pain-related side-effects, and their perception of pain as a result of orthodontic treatment with fixed appliances. *Eur J Orthod*. 1999;21:387–396.
27. Kafle D, Rajbhandari A. Anticipated pain and pain experience among orthodontic patients: is there any difference? *Kathmandu Univ Med J (KUMJ)*. 2012;38:71–73.
28. Ngan P, Kess B, Wilson S. Perception of discomfort by patients undergoing orthodontic treatment. *Am J Orthod Dentofacial Orthop*. 1989;96:47–53.
29. Jones M, Chan C. The pain and discomfort experienced during orthodontic treatment: a randomized controlled clinical trial of two aligning archwires. *Am J Orthod Dentofacial Orthop*. 1992;102:373–381.
30. Krishnan V. Orthodontic pain: from causes to management—a review. *Eur J Orthod*. 2007;29:170–179.