Research Paper: Relationship between the Severity of Tooth Crowding and Pain Perception at the Beginning of Fixed Orthodontic Treatment in a Population of Iranian Patients

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ABSTRACT

Introduction: Due to various reasons, pain during orthodontic treatment is an unpleasant experience which might lead to treatment discontinuing. This study evaluated the relationship between the severity of tooth crowding with the pain intensity at the beginning of orthodontic treatment in the dental school of Guilan University of Medical Sciences, Rasht, Iran.

Materials and Methods: In the present cross-sectional/analytical study, the severity of crowding was categorized into mild, moderate and severe. The questionnaires were distributed among the subjects at 1-, 6-, 12-, 18-, 24-, 72- and 96-hours postoperative intervals, and data were analyzed with SPSS 24.

Results: sixty subjects including 23 males and 37 females were evaluated. Thirty subjects were >21 and 30 were <21 years of age. The mean score of pain at 1-hour interval was reported to be 1.35, which increased significantly during the first 12 hours (3.5). The intensity of pain began to decrease significantly after the third day (P<0.05). Females and subjects <21 years of age higher pain intensity were reported. Also, pain was more severe in subjects with severe crowding compared to those with moderate and severe crowding, with no significant differences (P>0.05).

Conclusion: The results of the present study showed that pain perception at young ages was more severe than that at older ages. Pain during orthodontic treatment reaches a maximum after 12 hours, remains constant for some hours and decreases from the third day on, Although the pain severity was not significantly different in various degrees of crowding.

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Introduction

The popularity of orthodontic treatments is on the rise because these treatments aim to improve tooth alignment and esthetic appearance in order to improve facial esthetics (1). It has been reported that improvements in facial esthetic are the most essential reason of individual for seeking orthodontic treatment. The importance of the esthetic appearance of teeth and the face has been established in an individual's psychological status (2). Based on previous studies, it appears there is a strong relationship between the motives for orthodontic and surgical treatments and an individual's attitudes toward his/her dentofacial appearance and its deviation from the socio-cultural norms (3). For this reason, one of the most important advantages of orthodontic treatments over esthetic surgeries is to improve the esthetic appearance of the teeth and face in order to improve social and psychological satisfaction (4). Dental anomaly is, in fact, a deviation from the normal growth and development and a departure from the usual esthetic standards in a community, which affects the muscles and bones at young ages. Crowding is defined as a misalignment of teeth and occurs when there is a discrepancy between the size of the dental arch and the space required for the eruption of teeth. The space required for the correct eruption of teeth is determined by calculating the widths of all the teeth in the dental arch; the available space is determined by measuring the dental arch. If the required space is larger than the available space, the teeth will erupt in an unfavorable state, resulting in tooth crowding . Crowded teeth might affect the individual's esthetic appearance, resulting in psychological problems, which negatively affect the individual's quality of life (5,6).

The majority of individuals seeking orthodontic treatment have such problems. Orthodontic treatment might be annoying, requiring somatic and psychological counseling for those seeking this kind of treatment. Various studies have demonstrated that in many cases, discontinuation of the treatment might be due to the pain associated with orthodontic treatments

(7,8). Prospective studies on children and adults have shown that approximately 94% of the patients feel more severe pain during the first 24 hours during orthodontic treatment; however, the duration of pain has been reported to be different in different subjects (7).

Although the etiologic factor for pain resulting from orthodontic treatment has not been properly elucidated, it is believed that the pain results from a change in the circulation of the periodontal ligament and production of prostaglandins (9). Prostaglandins cause hyperalgesia, an increase in the permeability and dilation of blood vessels and an increase in the levels of histamine, bradykinin, acetylcholine and serotonin (10).

Furstman et al believe that pain is due to pressure, ischemia, inflammation and edema during orthodontic treatment (11). Pain has a multifactorial origin and is affected by gender, age, emotional and psychological status, and ethnicity (12). It should be pointed out that a recent study did not report a significant difference in pain perception of patients in terms of age or gender (13). It appears the difference between the two genders in pain perception is more due to cultured issues rather than to the physiology (14).

The pain during orthodontic treatment might have different reasons, which is an unpleasant experience for those undergoing orthodontic treatment and is also one of the reasons for the discontinuation of the treatment. Therefore, the present study aimed to evaluate the relationship between the severity of tooth crowding and pain perception at the beginning of fixed orthodontic treatment in the Specialty Clinic and Faculty of Dentistry, Gilan University of Medical Sciences, Rasht, Iran.

Materials and Methods

The present cross-sectional/analytical study was carried out to evaluate the relationship between tooth crowding and the severity of pain at the beginning of orthodontic treatment in patients referring to the Department of Orthodontics, Faculty of Dentistry, and the Specialty Clinic of this faculty in Rasht, Iran, in 2017-2018. Patients unwilling to take part in the study, those

who had undergone tooth extraction before the initiation of treatment and those who took analgesics during the study were excluded from the study. The samples size was determined based on a study by Alhaija et al (15) at 60 subjects by considering the frequency percentages of pain in Table 1 at a 95% confidence interval and a study power of 80%. The age range was variable, and the study was carried out on patients with permanent teeth, who required fixed orthodontic treatment due to tooth crowding.

All the patients underwent fixed orthodontic treatment with 016 NiTi wire and preadjusted 022 MBT system. The patients did not take any analgesics during treatment. The amount of crowding was analyzed on casts by analyzing the space from the mesial surface of the first molar tooth on one side to the mesial surface of the first molar tooth on the other side and categorized into mild, moderate and severe crowding groups (16).

(Mild: A space deficiency of ≤4 mm, Moderate: A space deficiency of 5–9 mm, Severe: A space deficiency of ≥10 mm)

Visual analogue scale(VAS) questionnaires were submitted to the patients at 1-, 6-, 12-, 24-, 48-, 72- and 96-hour intervals after the initiation of treatment and the data were collected and recorded. Data on the relationship between crowding and severity of pain were analyzed with Spearman's and chi-squared tests.

Repeated-measures test was used to analyze the severity of pain. SPSS 24 was used for all the statistical analyses.

Results

The results showed that 23 (38.3%) patients were male, and 37 (61.7%) were female. Thirty patients were >21 years of age, and 30 were ≤21 years old.

Table 1. A summary of the results of the evaluation of pain severity at the study intervals in terms of the mean pain severity

Interval	Mean pain score (SD)	Test statistics	P-value
1-hour	1.35 (1.86)	11.72	<0.001
6-hour	2.74 (2.55)		
12-hour	3.50 (2.73)		
18-hour	3.31 (2.62)		
24-hour	3.43 (2.84)		
48-hour	3.48 (2.86)		
72-hour	2.44 (2.73)		
96-hour	1.61 (2.43)		

As shown in Table 1, significant differences were detected in pain severity between the different intervals (P<0.001) (the repeated-measures test with Greenhouse-Geisser correction). The most and the least severe pains were reported at 12-hour and 1-hour intervals, respectively. Graph 1 presents the pain changes more clearly.
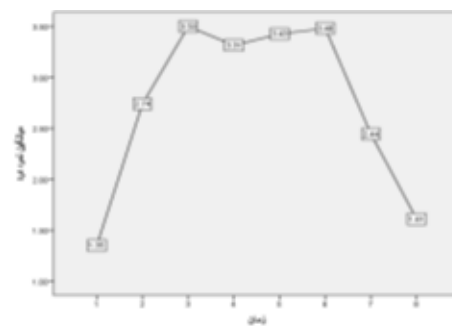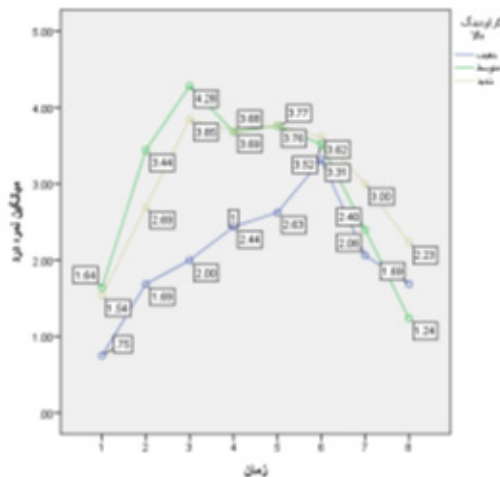

Graph 1. The changes in the mean pain severity scores at different study intervals.

Comparison of the mean pain scores between male and female subjects at each time interval showed that there were significant differences between these subjects only at 12-, 18- and 24-hour intervals (P<0.05). At all the time intervals, the mean pain scores of female subjects were higher than those of male subjects.
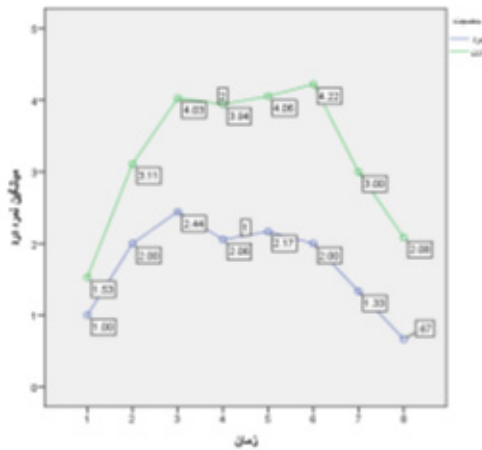
Evaluation of pain severity and its comparison between different ages showed that the mean pain scores were significantly different between the different time intervals (P<0.001). Changes were observed in the mean pain scores over time. However, the changes in the mean pain scores were not different between subject ≤21 years of age and those >21 years of age (P=0.773) (the repeated-measures test with Greenhouse-Geisser correction).

Graph 3. The changes in the mean pain scores at different intervals in terms of crowding in the maxilla.

Comparison of the mean pain scores between the subjects with mild, moderate and severe crowding at each time interval showed that the difference was significant only at 12-hour interval. Two-by-two comparisons at this interval showed a significant difference between the mean mild and mean moderate pain scores (P=0.037), with a higher mean score in the moderate pain group.

Discussion

Tooth crowding is one of the most important alveolodental anomalies, which requires orthodontic treatment because it has a negative effect on nutrition and the facial appearance of the affected individuals. In addition, this condition makes the teeth susceptible to trauma, periodontal diseases and dental caries (17). Furthermore, tooth crowding is not considered a pathologic condition with clear-cut characteristics; rather, it is a subjective and personal issue (18).

Patients undergoing orthodontic treatment experience some degrees of pain during different stages of treatment, with different severities in different individuals. This is one of the most important factors for refusing dental treatments, including orthodontic treatment. The present study evaluated the relationship between pain and the severity of tooth crowding in patients undergoing fixed orthodontic treatment. The results showed that the mean pain scores were low during the first hours after the initiation of treatment (1.35), which increased gradually up to 12 hours after the initiation of treatment, remaining almost constant for two days (3.48). However, after the third day, the pain decreased, with a score of 1.61 based on VAS. The difference in the mean pain scores were significant between different time intervals (P<0.05). In addition, the mean pain scores at different time intervals were different between male and female subjects, with higher pain scores in females compared to males at all the time intervals. However, the differences were not significant statistically (P>0.05).

Chaushu et al (19) reported that the pain in orthodontic patients might be relieved after two days, and orthodontists can inform their patients about this. Chen et al (20) and researchers in other studies (21,22) concluded that pain resulting from orthodontic treatment begins to decrease one day after the initiation of orthodontic treatment and reaches a normal level after seven days. In these studies, the severity of crowding has not been considered as a variable. Sabuncuoglu et al. reported that one hour after the initiation of orthodontic treatment the patients reported no pain. The

pain began after six hours and increased up to 12 hours, reaching a maximum at 24 hours. Although pain decreased on the third day, it was still a problem, decreasing significantly on day seven (23).

Bondemark et al (24) reported pain 4 hours after the initiation of treatment, with maximum pain after 24 hours. Ngan et al (25), too, reported that the severity of pain after the initiation of orthodontic treatment reached a maximum after 24 hours and decreased on the third day; however, there were differences in the time of initiation of pain, which was attributed to differences in the severity of the patients' tooth crowding and some other problems.

Philipp et al (26) reported pain in 65% of patients after 4 hours and in 95% after 24 hours. After seven days, 25% of patients still reported pain. Different studies have reported different time intervals for the initiation and termination of pain in orthodontic patients, indicating the role of different factors in the pain perception in these patients, including age, gender, the severity of crowding and pain threshold, which are different in different patients. However, in general, the mean hours of the intimation, culmination and termination of pain have been similar, to some extent, in different studies. In the present study, the severity of pain in patients ≤21 years of age was higher than that in patients >21 years of age at all the time intervals, except for the first hour; however, the difference was not significant statistically (P>0.05). Brown et al reported that adolescents (13-20 years of age) reported the most severe pain compared to children and adults (27).

In a study by Abdelrahman et al (2015), although the pain was more severe in young patients, there was no significant relationship between age and the severity of pain, consistent with the results of the present study (28). Patients with less severe crowding reported lower pain severity at all the intervals compared to those with moderate and severe crowding, except for the 4th day. The patients with moderate crowding reported the most severe pain from the first hour to the 12th hour, after which the group with severe crowding reported the most intense pain. However, the differences were not significant statistically (P<0.05). In addition, the study by Abdelrahman et al did not reveal a significant relationship between the severity of pain and the severity of crowding during orthodontic treatment (28). Previous studies on tooth crowding and pain during orthodontic treatment did not show any significant relationship between the applied force and the severity of crowding and the associated pain (29,30,31,32).

Markovic et al did not report any significant relationship between the quality and severity of pain and the severity of crowding of patients after the initiation of orthodontic treatment even with the use of different orthodontic wires, which is consistent with the results of the present study. However, they reported a clinical correlation between these two variables (33). Such a correlation was also observed in the present study. The results of a study by Jones (34), too, confirmed these results.

Conclusion

The results of the present study showed greater pain perception in adolescents compared to adults during orthodontic treatment. Usually, the pain began one hour after the initiation of treatment, culminating on the second day. Then the pain remained constant for some hours and began to decrease from the third day on. Although the severity of pain between patients with different severities of crowding was not significant statistically, the patients with severe crowding reported more severe pain clinically.

References

1.   Ackerman J, Proffit W, Sarver D. The emerging soft tissue paradigm in orthodontic diagnosis and treatment planning. Clin Orthod Res. 1999;2(2):49-52.https://doi.org/10.1111/ocr.1999.2.2.49

2.   Proffit W. The soft tissue paradigm in orthodontic diagnosis and treatment planning: a new view for a new century. J Esthet Dent. 2000;12(1):46-9.https://doi.org/10.1111/j.1708-8240.2000.tb00198.x

3.   Stricker G, Clifford E, Cohen L, Giddon D, Meskin L, Evans C. Psychosocial aspects of craniofacial disfigurement. A "State of the Art" assessment conducted by the Craniofacial Anomalies Program Branch, The National Institute of Dental Research. Am J Orthod.   1979;76(4):410-22.https://doi.org/10.1016/0002-9416(79)90226-4

4. Goodstein R. Burns: an overview of clinical consequences affecting patient, staff, and family. Compr Psychiatry. 1985;26(1):43-57.https://doi.org/10.1016/0010-440X(85)90048-3

5. Shaw W, Addy M, Dummer P, Ray C, Frude N. Dental and social effects of malocclusion and effectiveness of orthodontic treatment: a strategy for investigation. Community Dent Oral Epidemiol. 1986;14(1):60-4.https://doi.org/10.1111/j.1600-0528.1986.tb01497.x

6. Kenealy P, Frude N, Shaw W. An evaluation of the psychological and social effects of malocclusion: some implications for dental policy making. Soc Sci Med. 1989;28(6):583-91https://doi.org/10.1016/0277-9536(89)90253-0

7. Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. Am J Orthod and Dentofacial Orthop 1998; 114(6): 684 - 91https://doi.org/10.1016/S0889-5406(98)70201-X

8. Gosney MB. An investigation into factors which may deter patients from undergoing orthodontic treatment. . British Journal of Orthodontics. 1985; 12(3):133 - 8.https://doi.org/10.1179/bjo.12.3.133

9. White L. Pain and cooperation in orthodontic treatment. . J Clin Orthod 1984; 18(8):572-575

10. 10. Erdinc A, Dincer B. Perception of pain during orthodontic treatment with fixed appliances. Eur J Orthod. 2004; 26(1):79-85.https://doi.org/10.1093/ejo/26.1.79

11. Furstman L, Bernik S. Clinical considerations of the periodontium. . Am J Orthod. 1972; 61(2):138- 55.https://doi.org/10.1016/0002-9416(72)90092-9

12. Bird S, Williams K, Kula K. Preoperative acetaminophen vs ibuprofen for control of pain after orthodontic separator placement. Am J Orthod Dentofacial Orthop 2007; 132(4):5.4-10.https://doi.org/10.1016/j.ajodo.2006.11.019

13. Bergius M, Kiliaridis S, Berggren U. Pain in orthodontics. A review and discussion of the literature. J Orofac Orthop. 2000; 61(2):125-37.https://doi.org/10.1007/BF01300354

14. Lim H, Lew K, Tay D. A clinical investigation of the efficacy of low level laser therapy in reducing orthodontic post adjustment pain. Am J Orthod Dentofacial Orthop. 1995; 108(6):614-22.https://doi.org/10.1016/S0889-5406(95)70007-2

15. Alhaija A, A M, Nabaab A, F E, Maaitah A, et al. Comparison of personality traits, attitude toward orthodontic treatment, and pain perception and experience before and after orthodontic treatment. Angle Orthod. 2014;85(3)474-9 .https://doi.org/10.2319/121813-927.1

16. Proffit WR, Fields HW, Sarver DM. In: Proffit WR, Sarver DM(eds). Contemporary orthodontics. St.Louis: Mosby Elsevier,2013,chap6.

17. Graber T. Orthodontics principles and practice. 3rd Ed. W.B Saunders Co. 1995; Chap9:470- 485.

18. Miller J, Hobson P. The relationship between malocclusion, oral cleanliness, gingival condition and dental caries in school children. Br Dent J 1961; 111:43-52.

19. Chaushu G, Becker A, Zeltser R, Vasker N, Branski S, Chaushu S. Patients' perceptions of recovery after routine extraction of healthy premolars. Am J Orthod Dentofacial Orthop 2007; 131(1):170-5 https://doi.org/10.1016/j.ajodo.2005.06.024

20. Chen C-M, Chang C-S, Tseng Y-C, Hsu K-R, Lee K-T, Lee H-E. The perception of pain following interdental microimplant treatment for skeletal anchorage: a retrospective study. Odontology. 2010(1); 99:88-91.https://doi.org/10.1007/s10266-010-0152-1

21. Giannopoulou C, Dudic A, Kiliaridis S. Pain discomfort and crevicular fluid changes induced by orthodontic elastic separators in children. J Pain 2006; 7(1):367-76. .https://doi.org/10.1016/j.jpain.2005.12.008

22. Scheurer P, Firestone A, Bürgin W. Perception of pain as a result of orthodontic treatment with fixed appliances. Eur J Orthod 1996;18(1):349-57. https://doi.org/10.1093/ejo/18.1.349

23. Sabuncuoglu FA, Ersahan S, Erturk E. A comparision of two pain scales in the assessment of dental pain during initial phase of orthodontic treatment Journal of International Dental and Medical Research 2015;8(2):61-7.

24. Bondemark L, Fredriksson K, Ilros S. Separation effect and perception of pain and discomfort from two types of orthodontic separators. World J Orthod. 2004; 5:172-6.

25. Ngan P, Bradford K, Wilson S. Perception of discomfort by patients undergoing orthodontic treatment. Am J Orthod Dentofacial Orthop. 1989; 96(1): 47-53.https://doi.org/10.1016/0889-5406(89)90228-X

26. Philipp A, Scheurer, Allen R, Walter B, Burgin. Perception of pain as a result of orthodontic treatment with fixed appliances. European Journal of Orthodontics. 1996; 18(1):349-57.https://doi.org/10.1093/ejo/18.1.349

27. Brown DF, Moerenhout RG. The pain experience and psychological adjustment to orthodontic treatment of preadolescents, adolescents, and adults. Am J Orthod Dentofac Onhop. 1991; 10 (4): 349-56. https://doi.org/10.1016/0889-5406(91)70073-6

28. Abdelrahman, Reem S, Al-Nimri, Kazem S, Maaitah A, Emad F. Pain experience during initial alignment with three types of nickel-titanium archwires: a prospective clinical trial. Angle Orthod. 2015; 85(6):1021-6.https://doi.org/10.2319/071614-498.1

29. Ogura M, Kamimura H, Al-Kalaly A, Nagay-

ama K, Taira K, Nagata J, et al. Pain intensity during the first 7 days following the application of light and heavy continuous forces. Eur J Orthod. 2009; 31(1):314-9.https://doi.org/10.1093/ejo/cjn072

30.	Gonzales C, Hotokezaka H, Yoshimatsu M, Yozgatian J, Darendeliler M, Yoshida N. Force magnitude and duration effects on amount of tooth movement and root resorption in the rat molar. Angle Orthod. 2008; 78:502-9.https://doi.org/10.2319/052007-240.1

31.	Jian F, Lai W, Furness S, McIntyre G, Millett D, Hickman J, et al. Initial arch wires for tooth alignment during orthodontic treatment with fixed appliances. Cochrane Database Syst Rev. 2013; (4):CD007859.https://doi.org/10.1002/14651858.CD007859.pub3

32.	Luppanapornlarp S, Kajii T, Surarit R, Iida J. Interleukin-1beta levels, pain intensity, and tooth movement using two different magnitudes of continuous orthodontic force. Eur J Orthod. 2010; 32:596-601.https://doi.org/10.1093/ejo/cjp158

33.	Markovic E, Fercec J, Šćepan I, Glišić B, Nedeljković N, Juloski J, et al. The Correlation between Pain Perception among Patients with Six Different Orthodontic Archwires and the Degree of Dental Crowding Srp Arh Celok Lek. 2015 Mar-Apr; 143(3-4):134-40.https://doi.org/10.2298/SARH1504134M

34.	Jones M, Chan C. The pain and discomfort experienced during orthodontic treatment: a randomized controlled clinical trial of two initial aligning arch wires. Am J Orthod Dentofacial Orthop. 1992.373: 102-https://doi.org/10.1016/0889-5406(92)70054-E