PAIN AND CHEWING SENSITIVITY DURING FIXED ORTHODONTIC TREATMENT IN EXTRACTION AND NON-EXTRACTION PATIENTS

Sabit Ortodontik Tedavi Sırasında Çekimli ve Çekimsiz Hastalarda Ağrı ve Çiğneme Hassasiyetinin Değerlendirilmesi

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ABSTRACT

Purpose: The aim of this study was to evaluate the differences in pain perception and chewing sensitivity between extraction and non-extraction patients.

Subjects and Methods: Thirty orthodontic patients (11 males, 19 females) were included in this study who were classified as extraction (n=15; 6 males, 9 females) and non-extraction patients (n=15; 7 males, 8 females). The mean age of patients were 15.10±1.83 years in non-extraction group and 15.44±0.75 years in extraction group. The patients were asked to complete the Visual Analogue Scale (VAS) questionnaire and they were asked to mark the presence or absence of sensitivity during 7 days after the first arch wire placement. Pain intensity comparison between groups was performed using the Mann-Whitney U test. The Friedman test was used to analyze within-group differences over time.

Results: There were no significant differences in pain scores between the groups. Pain levels significantly decreased between day 1 and day 3 in both the groups. No differences were found in the chewing sensitivity between the non-extraction and extraction groups.

Conclusion: No difference in the pain perception was observed between the extraction and non-extraction patients during the 7 days after arch wire placement.

Keywords: Orthodontic treatment; brackets; pain; mastication; tooth extraction

ÖZ

Amaç: Bu çalışmanın amacı çekimli ve çekimsiz ortodontik tedavi hastalarında ağrı ve çiğneme hassasiyetindeki farklılığın değerlendirilmesidir.

Bireyler ve Yöntem: Çalışmaya çekimli (n=15; 6 erkek, 9 kadın) ve çekimsiz (n=15; 7 erkek, 8 kadın) olarak sınıflanan 30 ortodonti hastası (11 erkek, 19 kadın) dahil edilmiştir. Hastaların yaş ortalamaları çekimli hasta grubunda 15,10±1,83 yıl, çekimsiz hasta grubunda ise 15,44±0,75 yıldır. Hastalar ilk ark telinin takılmasını takip eden 7 gün boyunca bir Görsel Analog Skala anketi üzerinde ağrı ve çiğneme hassasiyetinin olup olmadığını işaretlemişlerdir. Gruplararası ağrı şiddetinin karşılaştırılmasında Mann-Whitney U testi kullanılmıştır. Grup içi farklılıkların karşılaştırılmasında Friedman testi kullanılmıştır.

Bulgular: Ağrı skorlarında gruplar arasında farklılıklar bulunmamıştır. Her iki grupta da ağrı seviyeleri 1. ile 3. gün arasında anlamlı oranda düşmüştür. Çekimli ve çekimsiz gruplar arasında çiğneme hassasiyetinde farklılık bulunmamıştır.

Sonuç: Ark teli yerleştirilmesini takiben 7 gün boyunca ağrı algısında çekimli ve çekimsiz hastalarda bir farklılık bulunmamıştır.

Anahtar kelimeler: Ortodontik tedavi; braket; ağrı; çiğneme; diş çekimi

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Pain in orthodontics

Introduction

Prolonged pressure produced by an orthodontic force applied to a tooth results in an acute inflammatory response with periodontal vasodilatation and subsequent osteoblastic and osteoclastic activity. Pressure in the periodontium is followed by ischemia, inflammation, and edema, which cause pain and discomfort (1-4). Thus, pain is usually experienced in response to an orthodontic force. Previous studies reported that 90%-95% of patients suffered from pain after orthodontic procedures (5, 6). Fear of pain may avoid a person from undergoing orthodontic treatment and can be a reason for discontinuing the treatment. About 10% of patients quit the orthodontic treatment because of pain (7). Pain perception is related to age, individual pain threshold, motivation, psychological condition, and previous negative dental experience of the patient and the magnitude of the orthodontic force (8). Previous reports have shown that older patients experienced more pain than younger patients (7, 9-11). Some previous reports showed that women complained more about pain than men (12, 13). However, other reports showed that gender differences were not related to pain perception (9, 14, 15).

After placement of an arch wire, pain begins in 4 hours and reaches the maximum level at 24 hours (5-7). The pain is at its highest level for 1–3 days and subsequently decreases in 7 days due to the beginning of orthodontic tooth movement (6, 7, 16, 17). Bergius et al. (5) reported that 25–42% of patients experienced pain even after 7 days of wearing elastic separators. Previous studies reported that pain after arch wire placement could be as worse as that experienced after tooth extraction (7, 14, 15). An orthodontist must keep in mind that pain is subjective and pain perception can vary from person to person. The relationship between the magnitude of orthodontic force and pain perception was studied by many researchers (9, 10, 18). Some researchers stated that large forces cause greater pain (4, 19). However, Jones (10) observed that there was no correlation between the initial crowding, applied forces, and the severity of pain. Pain perception can be evaluated using the Visual Analog Scale (VAS). The VAS enables the patients to indicate the precise intensity of their pain. To indicate the pain intensity, patients mark a point on a 100 mm horizontal line, corresponding to their pain intensity. It provides the maximum opportunity to each patient to express a personal response. VAS data are usually recorded as the number of millimeters on a line ranging from 0 to 100 (20). In most studies, VAS was used to evaluate pain perception because it is a rating scale with minimum constraints (21).

Subjects and Methods

Sample characteristics

The Human Ethics Committee (Clinical Research Ethics Committee) at Istanbul Medipol University approved this study and approval number was 10840098–47. The informed consents were obtained from all patients and their parents. The study group consisted of 30 patients (N=30) (11 males, 19 females) who were chosen from the patients scheduled to undergo orthodontic treatment. 15 extraction (n=15) (6 males, 9 females) and 15 non extraction (n=15) (7 males, 8 females) treatment patients were selected. Inclusion criteria for this study were as follows: (1 patients between 11 and 18 years, 2) no systemic disease, 3) no previous medication, 4) presence of crowding and fixed orthodontic treatment need in both upper and lower jaw. The mean amount of crowding of the patients were -7.1±3.4 mm in maxillary arch and -6.8±2.9 mm in mandibular arch in non-extraction group and -4.6±3.2 mm in maxillary arch and -3.2±2.4 mm in mandibular arch in extraction group. The mean ages of the patients were 15.10±1.83 years in non-extraction group and 15.44±.75 years in extraction group.

Orthodontic treatment protocol

All patients were treated by same author using 0.018 inch slot Gemini 3M Unitek metal brackets (Gemini, 3M Unitek, Monrovia, CA, USA). Extractions were made at least 2 weeks before bonding. Bonding of all brackets of upper and lower jaw was applied in the same visit. The initial (1st) arch wire was 0.012 inch nickel titanium (Nitinol classic, 3M Unitek, Monrovia, CA, USA) for all the patients and the arch wire was fully engaged in the bracket slots using elastomeric ligatures. No additional intra-oral or extra-oral appliances were placed. Similar oral hygiene instructions were given to all of the patients and
orthodontic wax was provided to all of them. Patients were advised to take an analgesic medication (acetaminophen, 500 mg tablet) in case of pain and discomfort. The dosing of analgesic was two tablets per day, every 12 hours and the timing for the first dose was after breakfast.

Assessment of the pain levels

Pain perception was measured using the VAS (Figure 1). The patients were asked to complete the VAS questionnaire on day 1 (at 24 hours) and on days 2–7 after the 1st arch wire placement. The patients were advised to complete the VAS questionnaire in the morning before taking their medication.

Statistical analysis

Statistical analysis were performed by Statistical Package for Social Science (SPSS for Windows, version 21.0, SPSS Inc., Chicago, IL, USA). Pain intensity comparison between the extraction and non-extraction group on each day was performed using the Mann-Whitney U test. The Friedman test was used to analyze the within-group differences over time, and two-sampled comparisons between the days were evaluated using the Iman-Conover method. The Fisher’s exact chi-squared test and Yates-corrected chi-squared test were used to determine significant differences in chewing sensitivity among groups. Inter-group comparisons of medication consumption were evaluated using the Yates’ chi-squared test. Distribution of the days of taking medication was also calculated. The significance level was set at \( p < 0.001 \). The power analysis was done by G*Power software (Ver. 3.0.10., Franz Faul, Universität Kiel, Kiel, Germany) at a significance level of \( \alpha = 0.05 \). Post-hoc statistical power of the study was found to be 89.7%.

Results

The mean age of the participants in the study showed similar age distribution and showed no significant differences between the groups according to an independent t-test. \( \text{(p=0.609)} \) The median pain scores, minimum and maximum values of the non-extraction and extraction groups are shown in Table 1. There were no significant differences in pain scores between the groups. Pain levels significantly decreased between day 1 and day 3 in both the groups. The results of chewing sensitivity are shown in Table 2. No differences were found in the chewing sensitivity between the non-extraction and extraction groups. In Table 2, two different statistical tests were used, a: The Fisher’s Exact chi-squared test was used the frequency of observations in each cell were with small sample size (lesser than 5) and b: Yates-corrected chi-squared test was used for the cells which contained sample sizes were larger than 5. Intra-group evaluation of chewing sensitivity indicated that the level of chewing sensitivity was significantly higher during the initial 4 days than that on days 5, 6, and 7 (Table 3 and Table 4).

Table 1. Pain assessments during 7 days with median, maximum, minimum and p values of the groups (Mann-Whitney U test).

| Pain | Non-extraction | Extraction |
|------|----------------|------------|
| Day 1 | 15 | 5 | 1 |
| Day 2 | 15 | 3 | 0 |
| Day 3 | 15 | 2 | 0 |
| Day 4 | 15 | 1 | 0 |
| Day 5 | 15 | 1 | 0 |
| Day 6 | 15 | 0 | 0 |
| Day 7 | 15 | 0 | 0 |

In the non-extraction group, 66.7% of the patients and in the extraction group, 60% of the patients reported taking analgesics. (Table 5) Frequency of the medication days is shown in Table 6. Among all the patients, 36.7% reported that they did not take any analgesic and the remaining patients reported taking analgesics.
Table 2. Percentage of chewing sensitivity in extraction and non-extraction groups (a: The Fisher’s Exact chi-squared test, b: Yates-corrected chi-squared test).

|        | Non-extraction | Extraction |
|--------|----------------|------------|
|        | No | % | Yes | % | No | % | Yes | % | p     |
| Day 1  | 0  | 0.0% | 15 | 100% | 2  | 13.3% | 13 | 86.7% | 0.483 | a |
| Day 2  | 1  | 6.7% | 14 | 93.3% | 1  | 6.7% | 14 | 93.3% | 1.000 | a |
| Day 3  | 1  | 6.7% | 14 | 93.3% | 2  | 13.3% | 13 | 86.7% | 1.000 | a |
| Day 4  | 2  | 13.3% | 13 | 86.7% | 2  | 13.3% | 13 | 86.7% | 1.000 | a |
| Day 5  | 6  | 40.0% | 9  | 60% | 6  | 40.0% | 9  | 60.0% | 1.000 | b |
| Day 6  | 9  | 60.0% | 6  | 40.0% | 8  | 53.3% | 7  | 46.7% | 1.000 | b |
| Day 7  | 11 | 73.3% | 4  | 26.7% | 10 | 66.7% | 5  | 33.3% | 1.000 | a |

Table 3. Chewing sensitivity assessment of non-extraction group in relation to Cochran’s Q test (p<0.001).

|        | Non-extraction | Extraction |
|--------|----------------|------------|
|        | No | % | Yes | % | No | % | Yes | % | p     |
| Day 1  | 0  | 0.0% | 15 | 100% | 2  | 13.3% | 13 | 86.7% | 0.483 | a |
| Day 2  | 1  | 6.7% | 14 | 93.3% | 1  | 6.7% | 14 | 93.3% | 1.000 | a |
| Day 3  | 1  | 6.7% | 14 | 93.3% | 2  | 13.3% | 13 | 86.7% | 1.000 | a |
| Day 4  | 2  | 13.3% | 13 | 86.7% | 2  | 13.3% | 13 | 86.7% | 1.000 | a |
| Day 5  | 6  | 40.0% | 9  | 60% | 6  | 40.0% | 9  | 60.0% | 1.000 | b |
| Day 6  | 9  | 60.0% | 6  | 40.0% | 8  | 53.3% | 7  | 46.7% | 1.000 | b |
| Day 7  | 11 | 73.3% | 4  | 26.7% | 10 | 66.7% | 5  | 33.3% | 1.000 | a |

Table 4. Chewing sensitivity assessment of extraction group in relation to Cochran’s Q test (p<0.001).

|        | Non-extraction | Extraction |
|--------|----------------|------------|
|        | No | % | Yes | % | No | % | Yes | % | p     |
| Day 1  | 2  | 13 | 1  | 14 | 13 | 14 |        |   |       |
| Day 2  | 1  | 14 | 1  | 14 | 13 | 14 |        |   |       |
| Day 3  | 2  | 13 | 1  | 14 | 13 | 14 |        |   |       |
| Day 4  | 6  | 9  | 1  | 14 | 13 | 14 |        |   |       |
| Day 5  | 9  | 7  | 1  | 14 | 13 | 14 |        |   |       |
| Day 6  | 8  | 7  | 1  | 14 | 13 | 14 |        |   |       |
| Day 7  | 10 | 5  | 1  | 14 | 13 | 14 |        |   |       |

Table 5. Distribution of patients in the groups of taking and non-taking medication. Yates-corrected chi-squared test (p<0.001).

|        | Non-medication | Medication | Total |
|--------|----------------|------------|-------|
|        | n  | % | n  | % | n  | % |
| Non-extraction | 5  | 33.3% | 10 | 66.7% | 15 | 100% |
| Extraction     | 6  | 40.0% | 9  | 60.0% | 15 | 100% |
| Total          | 11 | 36.7% | 19 | 63.3% | 30 | 100% |

Table 6. The frequency of medication days.

|      | Frequency | % |
|------|-----------|---|
| None | 11        | 36.7 |
| Day 1| 5         | 16.7 |
| Day 1, Day 2 | 9 | 30.0 |
| Day 1, 2, 3 | 4 | 13.3 |
| Day 1, 2, 3, and 6 | 1 | 3.3 |
| Total | 30 | 100 |

Discussion

This study included 30 patients (11 males and 19 females) who were chosen among the patients scheduled to undergo orthodontic treatment. To eliminate the effect of age on pain perception, patients of similar age were selected. Discrimination of gender was not considered because previous reports stated that pain and gender of the patient had no correlation with each other (9, 14, 15). Patients with Angle class I malocclusions that required extraction and non-extraction treatments were included in this study. Jones and Richmond (22) reported that there were no correlations between initial tooth positions, applied force, and discomfort; therefore, in this study, the amount of crowding was not evaluated, and the patients were classified only as non-extraction and extraction patients (23). Patients with similar age and social class were included in this study. All the fixed appliances were bonded using the same type of orthodontic brackets and the same size of arch wires on both the upper and lower jaws. To evaluate pain perception, the patients were asked to complete theVAS questionnaire and to mark the presence or absence of sensitivity during the 7 days after the 1st arch wire placement. The patients were advised to complete the questionnaire early in the morning to avoid the possible effects of medication on pain perception. The VAS questionnaire was reported to be the most reliable scale for evaluating subjective experiences. Therefore, VAS questionnaire was used to evaluate pain perception in this study (5, 11).

The results showed that the pain levels indicated by VAS scores had no significant differences between the extraction and non-extraction groups. In both groups, pain levels were significantly different between day 1 and day 3. Pain levels were maximum in day 1 and this finding confirms previous reports
(5, 7, 24, 25). Similar to previous reports, pain levels were the highest on day 1. After arch wire placement, the pain levels decreased significantly from day 3–7, similar to previous reports (15, 23). In this study, on day 2, the decrease in pain in the non-extraction group was higher than that in the extraction group; however, it was not statistically significant. On day 1 after arch wire placement, 93% of the patients reported pain; the number decreased to 30% after 7 days. Tecco et al. (26) reported that 95% of the patients treated by conventional metal brackets reported pain on day 1 after arch wire placement and 30% of them reported pain on day 8.

No reports regarding chewing sensitivity in fixed orthodontic treatment were found in the literature. The author of this article believes that orthodontic pain should be evaluated separately from chewing sensitivity. In this study, evaluation of chewing sensitivity showed that there were no significant differences between the extraction and non-extraction groups; however, in the initial 4 days, the level of chewing sensitivity was higher than that in the last 3 days in both of the groups. The breakpoint of pain level occurred on day 3 and the breakpoint of chewing sensitivity level occurred on day 4. According to the statements of the patients, most analgesics were consumed during the initial 2 days after ligation of the 1st arch wire. For analgesia, acetaminophen was advised in order to prevent the side effects of non-steroidal anti-inflammatory drugs. On day 7, the pain levels were significantly lower than that on day 1; although 30% of the patients reported pain on day 7, none of them used analgesics.

The most important limitation of this study is the duration of the observation. Longer observation time is needed to detect the pain perception between the extraction and non-extraction patients more precisely.

**Conclusion**

No differences in pain perception and chewing sensitivity were observed between the extraction and non-extraction patients. Pain decreased significantly from day 1 to day 3 and continued to decrease until day 7 in both of the two groups. Chewing sensitivity was higher in the initial 4 days of the 7 days than that in the last 3 days, in both groups. Thus, it would be appropriate to recommend analgesics to extraction treatment patients as well as non-extraction treatment patients during the initial 3 days of orthodontic treatment.

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**Conflict of interest**
None declared.

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