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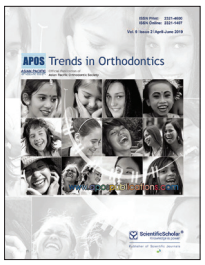

Original Article

The effects of orthodontic treatment type, depression, and treatment need on perceived pain intensity

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ABSTRACT

Objectives: The objectives of this study were to evaluate how orthodontic treatment type, treatment need, and depression affect perceived pain intensity (PPI).

Material and Methods: This prospective study included 172 patients (80 girls and 92 boys, mean age 14.32 ± 1.57 years) treated at the Sivas Cumhuriyet University Faculty of Dentistry, Department of Orthodontics. The patients were divided into three groups: the first group was treated with fixed orthodontic appliances, the second group was treated with twin blocks, and the third group was treated with rapid maxillary expansion and reverse headgear (RME/RH). Data were collected and classified with the Index of Orthodontic Treatment Need-Dental Health Component (DHC), Children's Depression Scale, and Visual Analog Scale. PPI was recorded in the 1st week (T0), 2nd week (T1), the 1st month (T2), 2nd month (T3), 3rd month (T4), and the 6th month (T5).

Results: PPI was higher in boys at T1 ($P = 0.005$) compared with girls. There was a significant difference of PPI between the treatment groups at T2 ($P = 0.036$), T3 ($P = 0.012$), T4 ($P = 0.000$), and T5 ($P = 0.006$). A statistically significant positive correlation was found between DHC and PPI at T3 (r = 0.182; $P = 0.000$), T4 (r = 0.161; $P = 0.03$), and T5 (r = 0.189; $P = 0.000$) time periods. There was no significant correlation between depression and PPI.

Conclusion: Girls were more resistant to pain than boys. The type of treatment and the need for treatment both had an effect on PPI. Further studies are needed to investigate the effects of psychological states on PPI during orthodontic treatment.

Keywords: Index of orthodontic treatment need, Pain, Depression, Maxillary expansion, Functional orthodontic, Fixed orthodontic appliance

INTRODUCTION

The aim of modern orthodontics is to offer patients treatment with as little pain as possible that results in a more comfortable life. However, orthodontic treatment inevitably has various side effects, such as pain.[1,2] Pain associated with orthodontic treatment is caused by inflammatory mediators such as cytokines and prostaglandins and occurs as a result of pressure put on the periodontal ligament and bone.[1] During orthodontic treatment, pain signals are sensed by nociceptors in the periodontal regions and sent to the trigeminal ganglia, trigeminal nucleus, ventroposterior nucleus, and then the sensory cortex.[3] Orthodontic pain typically begins 4 h after the application of orthodontic force, is at its highest intensity around 24 h, gradually decreases after 5–7 days, and returns to baseline after 14 days.[3,4]

Orthodontic applications such as separator placement, fixed orthodontic appliances, and debonding procedures can cause discomfort and pain.[5] Pain is a subjective response and is different for each individual.[6] However, as a procedure becomes more difficult, it is possible that the patient feels more pain. Many patients stated that pain started 24 h after the placement of fixed orthodontic appliances and caused more pain than removable appliances.[7] Studies have evaluated the perceived pain intensity (PPI) after the attachment of different types of brackets. Miles *et al*.[8] revealed that self-ligating brackets were more comfortable than conventional twin brackets.

Various indices are used to evaluate malocclusion. The Index of Orthodontic Treatment Need (IOTN) is a scoring system that was developed by Brook and Shaw.[9] The malocclusion severity can have an effect on the occurrence of pain. In one study, a significant correlation was reported between the orthodontic treatment need and oral pain.[10]

Depression is a complex disorder that manifests in different ways.[11] People suffering from depression tend to feel a greater sense of hopelessness or anger. Depression is characterized by the inability to cope with challenging life events.[12] Individuals with dentofacial deformities might be more prone to depression and experience work and social adjustment difficulties.[13,14] One study examined how depression affected the quality of life of patients with dentofacial deformity.[14] Another study examined biomarker levels in saliva in patients undergoing orthognathic surgery, and these parameters were associated with quality of life and psychological symptoms like depression.[15] To the best of our knowledge, no study has explored the relationship between depression and PPI during orthodontic treatment. The aim of this study is to determine the correlation of pain with treatment type, orthodontic treatment need, and depression.

MATERIAL AND METHODS

Study design, participants, and sample size

The Sivas Cumhuriyet University Non-Interventional Clinical Trials Ethics Committee approved the study and verbal and written consent was obtained individually from patients and their legal guardians (decision no: 2021-05/14).

The sample size was calculated assuming alpha of 0.05, beta of 0.20, and 80% power of the study, with a minimal relevant difference in the groups and variability of the outcome.[16] The minimum sample size was calculated as 120. This prospective study included 190 patients chosen at random from 300 applicants who met the inclusion criteria, then admitted to the orthodontic clinic between June and September 2021. Patients who did not receive orthodontic treatment before, had no missing teeth, no mucosal or periodontal disease, and had good oral hygiene were included in the study. Patients with any mental or physical illness were excluded from the study. Patients who used analgesics on the day of the pain assessment were also excluded from the study (n = 18).

The patients were evaluated in three groups as fixed orthodontic treatment (group 1), twin block (group 2), and rapid maxillary expansion and reverse headgear (RME/RH) (group 3). Patients in the fixed orthodontic treatment group had <7 mm crowding and non-extraction treatment was planned for them. The MBT 0.022" bracket system (Mini Master American Orthodontics, USA) was used for the fixed orthodontic treatment group. A 0.013" round nickel titanium arch wire (Tanzo Cu-Niti, American Orthodontics, USA) was used as the initial arch wire [Figure 1]. Additional appliances such as molar band, transpalatal arch, headgear, and miniscrew that could be an unpredictable pain source were excluded from the study. In the following sessions, 0.016," and 0.014" × 0.025" nickel titanium wires were inserted, respectively. The arch wires were replaced every 2 months. Descriptive data of the treatment groups are given in [Table 1].

Patients used twin blocks for at least 16 h/day and were examined at 4-week intervals by the same clinician (T.Ö.K.). Labial bows and Adams clasps were used on the lower part of the twin blocks. Slow expansion screws were installed in the upper portion of the appliances by keeping relative maxillary

Figure 1: Fixed orthodontic appliance.

Table 1: Descriptive data of the treatment groups.

Treatment groups	Gender		Total
	Female	Male	
FOT	29	35	64
Twin block	28	37	65
RME/RH	23	20	43

FOT: Fixed orthodontic treatment, RME/RH: Rapid maxillary expansion and reverse headgear

narrowness [Figure 2]. The expansion screw was used by the patients twice a week.

RME/RH developed by Baccetti *et al.*,[17] was used. To suspend the elastics between the canine and lateral teeth, two hooks were attached to the fully bonded RME appliance, which included a HYRAX screw (Leone Orthodontics and Implantology, Firenze, Italy; [Figure 3]). The screw was rotated two turns per day until the occlusal aspect of the maxillary first molar's lingual cusp came into occlusion with the facial cusp of the mandibular first molars. Following the completion of the expansion, the use of RH was started.[18] The procedure started with unilateral 8oz force and was increased to 14oz after the 2nd month. A Petit face mask was used to achieve maxillary protraction.

Data collection tools

IOTN

IOTN contains two components, which are the Dental Health Component (DHC), and the Aesthetic Component to assess the aesthetic need for orthodontic treatment. The DHC is a 5-grade index that ranks the patients' treatment needs; no need for treatment, little need for treatment, borderline need for treatment, great need for treatment, and a very great need for treatment. IOTN-DHC was used in the present study.

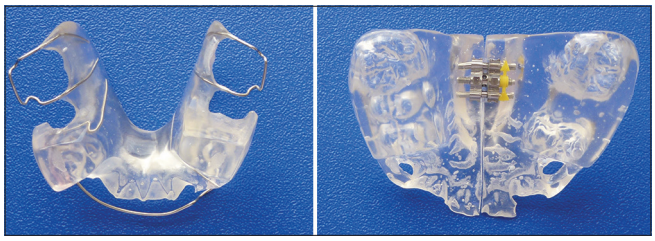

Figure 2: Twin block appliance used in the study.

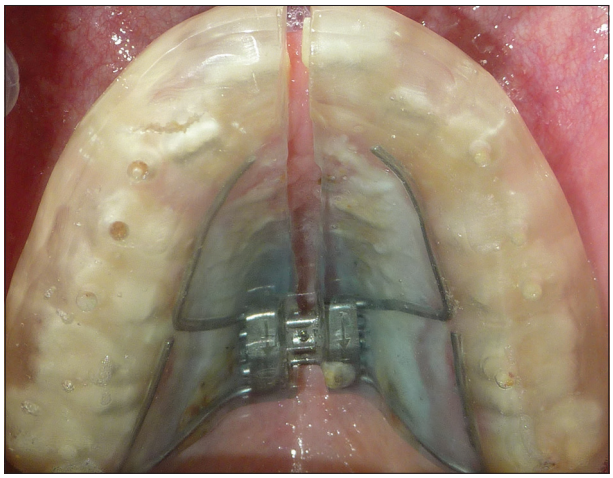

Figure 3: The full coverage rapid maxillary expansion appliance used in the study.

Children's depression scale (CDS)

The CDS is the most commonly used self-assessment scale for childhood depression in children aged 6–17 years and includes the most researched psychometric properties. In the 27-item scale, each item has three options. For the past 2 weeks, the child was asked to select the most appropriate sentence, for example, (1) occasionally feel depressed, (2) frequently depressed, and (3) always depressed. Depending on the severity of the symptom, each item received 0, 1, or 2 points. The highest score of the scale is 54. The higher the score, the more severe the depression. The validity and reliability of the scale was tested in a study by Öy on the Turkish population, and the pathology cutoff point was determined as 19 points.[19] CDS was administered to patients at the beginning of treatment.

Visual analog scale (VAS)

VAS is a simple tool used in pain assessment. It can be used on any patient who is older than 7 years old and has no motor function problems.[20] VAS has an unmarked 10 cm horizontal line with "no pain" (0 point) at the left end, and "worst pain" (100 points) at the right end.

VAS was used to assess patient pain levels in 1st week, 2nd week, 1st month, 2nd month, 3rd month, and the 6th month. The patients' routine control appointments were scheduled for every 4 weeks. In the 1st and 2nd weeks, patients were invited to the clinic for VAS applications. Following activation of the orthodontic appliances, VAS applications were made.

Statistical analysis

Data were analyzed using SPSS for Windows Version 25. The Skewness and Kurtosis coefficients were employed to assess whether or not the numerical data were normally distributed. According to Huck,[21] the Skewness and Kurtosis values should be between −1 and +1 for data to have a normal distribution. First, descriptive statistical analyses of the data were performed. The Mann–Whitney U-test was used to see if the means of non-normally distributed numerical data differed significantly between the two independent groups. The Kruskal–Wallis test was employed to determine if there was a significant difference between more than two independent groups. *Post hoc* analysis was performed with the Tamhane test. Repeated measure two-way analysis of variance was used to compare pain changes over time for the groups. Correlation between numerical data was tested with Spearman's correlation coefficient analysis. At a confidence level of 95%, $P = 0.05$ was accepted as statistically significant.

RESULTS

Eighty female and 92 male patients with a mean age of 14.32 ± 1.57 were included in the present study. [Table 2] shows DHC

and mean pain over time. [Table 3] shows pain changes in terms of gender. In the 2nd week, the VAS score of male patients was significantly higher than the score of their female counterparts (P = 0.005). Pain changes between the genders within the groups are presented in [Table 4]. There was a significant difference in 2nd week pain levels between boys and girls, in the twin block (P = 0.008) and RME/RH (P = 0.011) groups. For the RME/RH group, there was a significant difference in pain levels in the 1st month, between boys and girls (P = 0.016).

[Table 5] shows pain changes in terms of treatment groups. The changes observed in the 1st (P = 0.036), 2nd (P = 0.012), 3rd (P = 0.000), and 6th (P = 0.006) months were statistically significant. In terms of pain change over time, there was no significant difference between treatment groups (P>0.05; repeated measures two-way analysis of variance; [Figure 4]).

[Table 6] shows data on the descriptive and internal consistency of CDS. The Cronbach's alpha value, which indicates the internal consistency of the CDS, was 0.754.

Table 2: Descriptive statistics for study variables.

Variables	*n*	Mean	SD
DHC	172	3.79	0.71
1st week VAS	172	4.84	2.52
2nd week VAS	172	2.32	2.18
1st month VAS	172	1.35	1.80
2nd month VAS	172	1.00	1.79
3rd month VAS	172	0.76	1.55
6th month VAS	172	0.58	1.32

DHC: Dental health component, SD: Standard deviation, VAS: Visual analog scale

[Table 7] shows the correlation values between DHC, depression, and pain changes. The correlation between DHC and VAS in the 2nd (r = 0.182; P = 0.000), 3rd (r = 0.161; P = 0.03), and 6th (r = 0.189; P = 0.000) months was statistically significant. There was no statistically significant correlation between depression, the need for orthodontic treatment, or PPI.

DISCUSSION

Pain is a complex feeling that differs from one individual to another, therefore making it difficult to assess objectively. More than one instrument is required to assess pain intensity.[22] When an appropriate device is given, children as young as 3 years and older have been shown to understand the concept of pain and the varying degrees of severity.[23] VAS was used to determine pain in this study, and as with Almasoud[24] and Kaur *et al.*,[25] overall, we reported PPI was low–to-moderate in all three treatment groups. The pain level decreased over time, reaching its lowest point in the 6th month. This finding is consistent with studies by Wiedel and Bondemark.[7]

The studies have revealed that gender is not a significant factor in reporting pain.[26,27] The present study's data show that boys had significantly higher rates of pain than girls in 2nd week. According to Campos *et al.*,[28] the level of pain differed significantly by gender. Contrary to this study, women have been shown to be more prone to pain.[29]

In the present study, pain levels were measured after the activation of the orthodontic appliances. Long *et al.*[2] examined pain levels after initial arch wire engagement.

Table 3: Pain levels according to gender.

Gender	1st week VAS		2nd week VAS		1st month VAS		2nd month VAS		3rd month VAS		6th month VAS	
	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*
Female	4.71±2.59	0.266	2.00±2.09	0.005*	1.17±1.66	0.111	0.92±1.69	0.766	0.73±1.49	0.801	0.48±1.11	0.489
Male	5.10±2.37		2.96±2.22		1.70±2.03		1.17±1.98		0.81±1.66		0.79±1.65	

Mann Whitney-U test, *P<0.05. VAS: Visual analog scale, SD: Standard deviation

Table 4: Pain levels between genders within groups.

Treatment groups	Gender	1st week VAS		2nd week VAS		1st month VAS		2nd month VAS		3rd month VAS		6th month VAS	
		Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*
FOT	Female	4.90±2.69	0.512	2.09±2.07	0.616	1.23±1.60	0.357	0.76±1.49	0.128	0.55±1.51	0.244	0.34±0.84	0.121
	Male	4.52±2.35		1.80±1.93		0.85±1.23		0.28±0.78		0.14±0.47		0.23±1.09	
Twin block	Female	4.46±2.69	0.251	1.82±2.14	0.008*	0.97±1.67	0.246	0.66±1.12	0.707	0.60±1.17	0.672	0.33±0.95	0.122
	Male	5.15±2.17		3.30±2.02		1.35±1.72		1.20±2.09		0.45±0.99		1.25±2.26	
RME/RH	Female	4.80±2.28	0.090	2.15±2.11	0.011*	1.42±1.77	0.016*	1.61±2.53	0.273	1.26±1.88	0.194	0.96±1.58	0.687
	Male	5.82±2.55		4.00±2.23		3.17±2.42		2.23±2.41		2.05±2.46		0.94±1.19	

Mann–Whitney U-test, *P<0.05, VAS: Visual analog scale, FOT: Fixed orthodontic treatment, RME/RH: Rapid maxillary expansion and reverse headgear, SD: Standard deviation

Table 5: Pain levels according to treatment groups.

Treatment groups	1st week VAS		2nd week VAS		1st month VAS		2nd month VAS		3rd month VAS		6th month VAS	
	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*	Mean±SD	*P*
FOT *n*=64	4.78±2.57	0.552	2.00±2.02	0.133	1.10±1.49	0.036*ab	0.60±1.31	0.012*a	0.42±1.28	0.000*ab	0.31±0.92	0.006*a
Twin block *n*=65	4.66±2.54		2.27±2.20		1.09±1.68		0.83±1.49		0.55±1.11		0.61±1.52	
RME/RH *n*=43	5.20±2.41		2.88±2.32		2.11±2.20		1.86±2.47		1.58±2.12		0.95±1.43	

Kruskal Wallis-H *$P<0.05$. [a]Difference between FOT and RME/RH, [b]Difference between Twin block and RME/RH. VAS: Visual analog scale, FOT: Fixed orthodontic treatment, RME/RH: Rapid maxillary expansion and reverse headgear, SD: Standard deviation

Table 6: Distribution of children's depression scale scores and internal consistency values.

Depression scale score	Number of questions	27
	Cronbach's alpha	0.754
	Min-Max (Median)	0–30 (7)
	Mean±SD	9.48±5.90

SD: Standard deviation

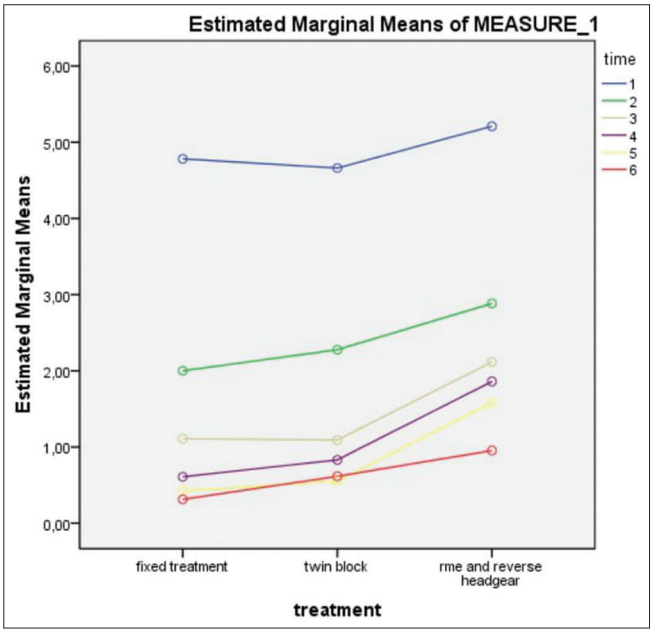

Figure 4: Pain changes in treatment groups over time.

Similarly, Campos *et al.*[28] assessed pain levels following orthodontic appliance activation. Pain levels in the treatment groups decreased over time in the present study. The highest pain intensity in orthodontic treatments was reported 24 h after orthodontic activation.[30] The fact that the measurements were taken after activation could explain the decrease in pain levels.

The type of appliance used can have an impact on the PPI. According to a previous review, fixed appliances cause more pain, because they apply constant force, whereas removable appliances cause less pain because the force application is more intermittent.[31] In the present study, there was no significant difference between fixed orthodontic treatment and the twin block in terms of pain levels, but pain levels of the twin block group were lower in the beginning and increased from the 2nd month compared to the fixed treatment group. One study found minor changes in PPI between fixed orthodontic treatment and removable treatment options.[7] This finding was refuted by Kavaliauskiene *et al.*,[32] who claimed that fixed and functional appliances produced more PPI than removable appliances. The RME/RH group experienced the most pain in this current study. It has been reported that the majority of RME patients experience pain, particularly during the early stages of expansion.[26] Here, we observed that the highest level of pain was detected during the 1st week of expansion and gradually decreased over time.

Individuals with a high need for orthodontic treatment have a lower quality of life.[33] Here, we found that as the need for treatment increased, so did the PPI. Keshavarz *et al.*[34] found no significant difference between the severity of pain and the degree of crowding during orthodontic treatment. Marković *et al.*[35] reported that despite the use of different orthodontic arch wires, there was no significant relationship between the severity of pain and the severity of crowding after initiation of orthodontic treatment, but there was a clinical correlation between these two variables. Age, racial differences, treatment protocols, and evaluation criteria may have affected the results of the studies.

The amount of pain reported by patients is largely determined by the individual's psychological well-being as well as the magnitude of the applied force.[36] Orthodontic pain is reported to have an effect on the psychosocial and behavioral aspects of a patients' life.[28] Depression is common in the general population. Depressed adolescents, unlike adults, are often agitated, very active, and prone to risk-taking, while constantly devaluing themselves.[37] In one study, people who were uncooperative during orthodontic treatment were more depressed.[38] De Ávila *et al.*[14] concluded that in patients with

Table 7: Correlations for study variables.

Variables	DHC	CDS	1st week VAS	2nd week VAS	1st month VAS	2nd month VAS	3rd month VAS	6th month VAS
DHC	–	−0.083	−0.051	0.009	0.085	0.182**	0.161*	0.189**
CDS	–	–	0.120	0.101	−0.014	−0.114	−0.033	−0.051

Spearman correlation coefficient **Correlation is significant at the 0.01 level. *Correlation is significant at the 0.05 level. DHC: Dental health component, SD: Standard deviation, VAS: Visual analog scale, CDS: Children's depression scale

dentofacial deformity, depression significantly interferes with vitality, social aspects of the individual, and mental health. They also reported that individuals with depression and dentofacial deformity had a poorer quality of life.[14] Beck *et al*.[39] discovered that those with high dental anxiety and pain catastrophizing, which is considered a maladaptive coping strategy that intensifies the experience of pain and depression, had greater pain levels during orthodontic treatment. In one study, a low level of positive correlation was found between pain and depression, and it was concluded that dental anxiety was more effective on pain than depression.[40] In contrast, the present study found no correlation between depression and PPI. While some studies have shown that depressed patients have a lower pain threshold,[41,42] others have found the opposite.[43,44] These mixed findings suggest the need for more detailed evaluations.

Limitations

The generalizability from the present study is limited, because patients with malocclusion from a specific age group and from a university orthodontics clinic were included in the study.

CONCLUSION

RME/RH treatment is more painful than other types of orthodontic treatment. Boys reported significantly more pain than girls in 2nd week. In the 2nd, 3rd, and the 6th months, there was a positive and significant relationship between DHC and PPI. Comprehensive studies are needed to further determine the relationship between depression and PPI.

Ethics committee approval

The Sivas Cumhuriyet University Non-Interventional Clinical Trials Ethics Committee approved the study (decision no: 2021-05/14).

Peer-review

Externally peer-reviewed.

Author contributions

Concept - Z.Ç.B.; Design - Z.Ç.B.; Supervision - Z.Ç.B.; Data Collection and/or Processing - T.Ö.K.; Analysis and/or Interpretation - Z.Ç.B.; Literature Review - Z.Ç.B.; Writing - Z.Ç.B., T.Ö.K.; Critical Review - Z.Ç.B.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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None.

Conflicts of interest

There are no conflicts of interest.

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