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Relationship between Physiological-Emotional State and the Perception of Pain during Bracket Debonding

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ABSTRACT

Objective: Pain is a subjective phenomenon and it is highly affected by individual variations. The aim of this study was to investigate the effects of physiological-emotional state on perceived pain during bracket debonding.

Materials and Methods: Sixty-six participants with the mean ages of 16.73 ±2.61 years (38 females, 16.58 ±2.49 years; 28 males, 16.94 ±2.80) who were in the stage of debonding were enrolled in the study. The participants completed the Beck Depression Inventory and Pain Catastrophizing Scales before removing the brackets, and pressure pain thresholds were detected by using the algometer device. Following the debonding of the brackets, the perception of pain for each tooth was measured using the Visual Analog Scale. It was investigated whether there were significant correlations between the perceived pain and the variables investigated using Spearman's rank correlation coefficient. Statistical analysis was performed separately for both female and male groups.

Results: There were no statistically significant differences between the gender groups of any of the investigated variables. A total of 144 correlations were examined between the pain scores of 24 teeth and the six investigated variables. Eleven and six correlations were found statistically significant in females and males, respectively. For the remaining 133 and 138 correlations in females and males respectively, there was no statistical significance. In both genders, mean pain scores were higher in the lower anterior region.

Conclusion: Although few correlations were found statistically significant, there was no remarkable relationship between the physiological-emotional state and debonding pain.

Key words: Beck depression inventory, Debonding pain, Pain catastrophizing scale, Pressure pain threshold

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INTRODUCTION

Pain is a side effect that is frequently experienced during orthodontic procedure and causes patients to avoid treatment. Although different percentages have been reported, studies have shown that almost 90% of patients undergoing orthodontic treatment experienced pain at different stages of the treatment [1-5]. O'Connor has revealed that pain was the most unpleasant situation during treatment and fourth among major fears and apprehensions prior to orthodontic treatment [6]. Pain has a significant effect on patient compliance. Pain deteriorates the cooperation needed to ensure the proper progression of treatment. It may even result in complete termination of treatment by the patient. Krishnan stated that the primary causes of poor cooperation were pain, functional and aesthetic impairment caused by the appliances [2]. Patel said that 8% of orthodontic patients had chosen to discontinue treatment because of pain [7].

Separation, archwire placement, force activation, and debonding have been expressed as the main stages of treatment that cause pain [2]. Studies on debonding pain have been published in literature since the early 1990s [8-10]. In a study evaluating the level of patient discomfort at the time of debonding, Williams and Bishara stated that the level of debonding pain was significantly influenced by two factors: the mobility of the tooth and the direction of application of force [8]. Sex and tooth types were also found to be effective at the level of discomfort. Additionally, they concluded that patients could withstand

intrusive forces significantly more than forces applied in a mesial, distal, facial, lingual, or an extrusive direction. Therefore, they have suggested applying finger pressure or asking the patient to bite on a piece of cotton roll to minimize pain while debonding [8]. Rinchuse has recommended using occlusal rim wax for pain-free debonding [11].

Pain is a subjective phenomenon and it is argued that it is affected by many individual variations such as age, gender, individual pain threshold, present emotional state and stress, cultural differences, and previous pain experiences [2]. Like its presence in dental and skeletal characters, sexual dimorphism may take a role in the perception of pain [12]. Generally, it was stated that females suffer more from pain than males. Reporting more pain by female patients was associated with their fragility and sensitivity to pain [13]. However, this matter is not clear and there are studies that showed no difference between males and females in reporting the feeling of pain [2]. Similarly, conflicting results are reported for the effect of age on pain [4,14]. Although individual variations such as pain threshold, present emotional state and stress, cultural differences, and previous pain experiences were stated to have an impact, there is a scarcity in the literature about these variations, except for gender and age. We think the publications on the issue of present emotional state and stress is especially important in clarifying whether the perceived feeling is a genuine pain or somatization of anxiety and depression.

Although various treatment techniques and materials are becoming increasingly popular today, metal brackets are still widely used. Many aspects of the metal bracket from different debonding techniques to cytotoxicity of its identification dyes have been studied [9-11,15]. The aim of this study was to investigate the effects of the physiologic-emotional state on perceived pain during the bracket debonding procedure.

MATERIAL AND METHODS

This study was reviewed and approved by the Clinical Research Ethics Committee. The study was conducted on a patient group treated at the Orthodontic Clinic. Sixty-six patients (38 females, 28 males) undergoing fixed orthodontic treatment and whose treatments were at the bracket debonding stage were included in the study. Inclusion and exclusion criteria were as follows: being at the stage of debonding, having 0.018" stainless steel brackets as a fixed appliance, not having a medical history, and no analgesic medication had been taken during the week leading up to the procedure.

Patients included in the study were invited to the clinic between 10:00 and 14:00 for bracket removal. Before the bracket debonding procedure, a Beck Depression Inventory and Pain Catastrophizing Scale (PCS) were given to the patients and they were asked to complete the forms. Additionally, pressure pain thresholds were measured with the use of a pressure pain algometer device (Wagner FPK, Wagner Instruments, Greenwich, CT, USA). The Beck Depression Inventory is a psychometric test made up of a series of questions to detect the severity of depression. Pain catastrophizing was defined as the tendency to magnify the threat value of a pain stimulus and to feel helpless in the presence of pain [16]. The Pain Catastrophizing Scale is a survey that measures this condition and contains thirteen items that are grouped under three subscales. The pressure algometer device is apparatus that documents the pain threshold by quantifying the levels of muscle, joint, tendon, and ligament tenderness. The measurement is performed by applying continuous pressure at a constant rate on the patient's skin.

Following the measurements, debonding was performed with the aid of a bracket removing plier (Luno, American Orthodontics, Sheboygan, Wis, USA). Prior to debonding, the procedure was explained to the patient, but no effort was made to calm the patient. The debonding procedure of all patients was performed by the same researcher using the same debonding plier throughout the study. During the procedure, patients were asked to open their mouths and it was ensured that the teeth were not in contact with counter teeth. The sequence of the bracket debonding was as follows: 16, 36, 46, 26; 15, 35, 45, 25; 14, 34, 44, 24; 13, 33, 43, 23; 12, 32, 42, 22; 11, 31, 41, 21. There was a wait of 10 seconds after removing each bracket before the next bracket was removed. Teeth with restoration at the bracket-placed area were excluded from the study. The archwires were in situ during the operation.

The severity of pain was recorded using a 10-cm visual analog scale (VAS). Patients were instructed on how to measure their pain perceptions by using VAS forms. A separate VAS form was used for each tooth; a 0 to 10-point scale indicated no pain to intolerable pain, respectively.

Statistical analysis

Statistical analysis was performed using the Number Cruncher Statistical System (NCSS 2007, NCSS, LLC, Kaysville, Utah, USA). For all data, descriptive statistics including mean and standard deviation were calculated and the distributions of the data were evaluated using the Shapiro-Wilk test. Student's t-test and Mann-Whitney U test were utilized for comparing the groups. Spearman's rank correlation coefficient was used to determine the correlations between the data. P values of less than 0.05 were considered statistically significant.

RESULTS

The mean ages for female and male participants were 16.58 ±2.49 years and 16.94 ±2.80, respectively. Comparisons of the pressure pain threshold, Beck Depression Inventory, Pain Catastrophizing Scale, and its subscales scores (helplessness, magnification, and rumination) between female and male groups were presented in Table 1. There were no statistically significant differences between the groups in any of the variables. Correlations between pain scores and variables for each tooth were shown separately in Tables 2 and 3 for females and males, respectively.

In the female group, there were statistically significant positive correlations between the following: pressure pain threshold and VAS score of tooth number 15; PCS total score and

Table 1: Comparisons of the variables between females and male groups.

		Mean ± standard deviation	p
Pressure pain threshold score	Female	3.53 ± 0.5	0.437b
	Male	3.64 ± 0.59	
Beck Depression Inventory score	Female	5.5 ± 4.29	0.519a
	Male	7.07 ± 6.13	
Pain Catastrophizing Scale (PCS) Total score	Female	13.11 ± 9.5	0.516a
	Male	14.18 ± 8.56	
Pain Catastrophizing Scale (PCS) Helplessness score	Female	5.13 ± 4.19	0.494a
	Male	5.57 ± 3.53	
Pain Catastrophizing Scale (PCS) Magnification score	Female	3.47 ± 2.24	0.822b
	Male	3.61 ± 2.56	
Pain Catastrophizing Scale (PCS) Rumination score	Female	4.5 ± 3.94	0.514a
	Male	5 ± 3.86	

aMann-Whitney U test, b Student's t-test, *p<0.05

Table 2: Examining the relationship between VAS scores and variables in female participants.

Tooth number/mean VAS score (cm)		Pressure pain threshold score	Beck Depression Inventory score	PCS Total Score	PCS Helplessness Score	PCS Magnification Score	PCS Rumination Score
16 (0.91 ± 1.48)	r	0.171	-0.032	-0.162	-0.169	-0.18	-0.051
	p	0.459	0.891	0.482	0.464	0.435	0.825
36 (0.62 ± 1.12)	r	-0.008	-0.089	-0.04	-0.054	-0.05	0.06
	p	0.968	0.64	0.832	0.776	0.792	0.754
46 (0.67 ± 1.18)	r	0.103	-0.042	-0.016	0.032	-0.099	-0.016
	p	0.589	0.826	0.933	0.868	0.602	0.933
26 (0.64 ± 1.11)	r	-0.021	-0.023	0.104	0.061	0.11	0.113
	p	0.926	0.92	0.645	0.786	0.625	0.617
15 (0.76 ± 1.55)	r	0.537	0.232	0.349	0.298	0.234	0.411
	p	0.001*	0.174	0.037*	0.077	0.169	0.013*
35 (0.28 ± 0.53)	r	-0.144	-0.258	-0.03	-0.022	-0.096	-0.006
	p	0.401	0.129	0.863	0.897	0.578	0.973
45 (0.39 ± 0.68)	r	-0.13	-0.104	0.004	0.053	-0.02	-0.024
	p	0.443	0.542	0.979	0.757	0.905	0.888
25 (0.53 ± 0.85)	r	-0.106	0.149	0.109	0.171	0.109	0.15
	p	0.538	0.386	0.528	0.319	0.525	0.382
14 (1.08 ± 1.59)	r	0.091	0.035	0.245	0.292	0.193	0.342
	p	0.652	0.862	0.217	0.14	0.335	0.081

34 (0.36 ± 0.64)	r	0.184	-0.046	0.141	0.214	0.002	0.141
	p	0.304	0.798	0.435	0.231	0.993	0.434
44 (0.5 ± 0.77)	r	0.165	0.128	0.188	0.235	0.052	0.243
	p	0.35	0.47	0.286	0.181	0.772	0.165
24 (0.34 ± 0.61)	r	0.194	-0.061	0.05	0.09	-0.008	0.2
	p	0.333	0.762	0.803	0.655	0.97	0.317
13 (0.76 ± 1.28)	r	0.314	0.08	0.364	0.31	0.248	0.443
	p	0.055	0.631	0.025*	0.059	0.134	0.005*
33 (0.54 ± 1.06)	r	0.126	0.026	0.12	0.156	-0.055	0.179
	p	0.458	0.878	0.479	0.357	0.748	0.29
43 (0.87 ± 1.38)	r	-0.223	0.027	0.104	0.097	0.099	0.086
	p	0.184	0.872	0.542	0.567	0.558	0.614
23 (0.89 ± 1.44)	r	0.035	-0.13	0.211	0.175	0.181	0.275
	p	0.838	0.442	0.21	0.302	0.282	0.099
12 (1.4 ± 1.79)	r	0.267	-0.12	0.133	0.118	0	0.105
	p	0.11	0.478	0.432	0.488	0.999	0.536
32 (1.04 ± 1.64)	r	0.177	0.079	0.119	0.103	0.059	0.178
	p	0.303	0.648	0.489	0.549	0.731	0.3
42 (1.64 ± 1.94)	r	0.244	0.042	0.272	0.249	0.279	0.218
	p	0.151	0.806	0.108	0.143	0.099	0.202
22 (1.26 ± 1.49)	r	0.137	0.124	0.496	0.459	0.454	0.463
	p	0.425	0.472	0.002*	0.005*	0.005*	0.004*
11 (1.28 ± 2.17)	r	0.123	0.114	0.317	0.294	0.203	0.323
	p	0.461	0.497	0.052	0.073	0.22	0.048*
31 (1.35 ± 1.65)	r	0.228	0.127	0.301	0.27	0.178	0.31
	p	0.174	0.453	0.07	0.107	0.293	0.061
41 (1.18 ± 1.71)	r	-0.096	0.061	0.125	-0.004	0.235	0.111
	p	0.572	0.721	0.461	0.983	0.161	0.514
21 (1.25 ± 1.97)	r	0.198	0.155	0.255	0.154	0.188	0.373
	p	0.233	0.354	0.122	0.355	0.258	0.021*

Spearman's rank correlation coefficient, PCS: Pain Catastrophizing Scale, *p<0.05

Table 3: Examining the relationship between VAS scores and variables in male participants.

Tooth number/mean VAS score (cm)		Pressure pain threshold score	Beck Depression Inventory score	PCS Total score	PCS Helplessness score	PCS Magnification score	PCS Rumination score
16 (0.27 ± 0.63)	r	0.396	-0.025	-0.062	-0.061	0.076	-0.051
	p	0.068	0.911	0.783	0.788	0.736	0.823
36 (0.56 ± 0.92)	r	-0.24	-0.113	-0.137	-0.14	0.024	-0.141
	p	0.258	0.6	0.523	0.514	0.912	0.511
46 (0.5 ± 1.25)	r	0.185	-0.061	-0.286	-0.183	-0.338	-0.106
	p	0.387	0.777	0.175	0.391	0.107	0.622
26 (0.96 ± 1.85)	r	-0.379	-0.006	-0.064	-0.087	0.047	-0.018
	p	0.067	0.977	0.766	0.684	0.826	0.932
15 (0.37 ± 0.77)	r	-0.089	-0.133	-0.099	-0.088	0.025	-0.035
	p	0.666	0.516	0.631	0.667	0.904	0.866
35 (0.33 ± 0.92)	r	0.432	-0.145	-0.054	0.002	-0.03	-0.036
	p	0.035*	0.498	0.803	0.993	0.888	0.869
45 (0.48 ± 0.77)	r	-0.073	0.209	-0.068	-0.072	-0.042	-0.021
	p	0.733	0.326	0.752	0.738	0.845	0.921
25 (0.23 ± 0.5)	r	-0.065	-0.429	-0.44	-0.381	-0.063	-0.573
	p	0.757	0.032*	0.028*	0.06	0.766	0.003*
14 (0.67 ± 1.03)	r	0.106	-0.092	0.037	0.034	0.088	0.157
	p	0.608	0.655	0.859	0.868	0.668	0.444
34 (0.36 ± 0.91)	r	0.194	-0.02	0.092	-0.024	0.018	0.226
	p	0.364	0.927	0.669	0.913	0.934	0.288
44 (0.27 ± 0.86)	r	0.501	0.089	0	-0.023	0.041	-0.017
	p	0.015*	0.686	0.99	0.916	0.853	0.938
24 (0.7 ± 1.29)	r	0.102	-0.081	0.099	0.183	0.015	0.04
	p	0.642	0.715	0.654	0.402	0.946	0.857
13 (0.72 ± 1.38)	r	-0.22	-0.176	-0.256	-0.289	-0.139	-0.16
	p	0.261	0.369	0.188	0.135	0.479	0.417

33 (0.36 ± 0.91)	r	-0.019	0.113	-0.215	-0.246	-0.034	-0.172
	p	0.927	0.591	0.301	0.236	0.872	0.41
43 (0.58 ± 1.02)	r	0.23	-0.014	-0.093	-0.017	0.023	-0.199
	p	0.269	0.947	0.658	0.936	0.911	0.339
23 (0.58 ± 0.99)	r	-0.115	-0.271	-0.069	-0.064	0.213	-0.188
	p	0.562	0.163	0.726	0.748	0.277	0.337
12 (0.85 ± 1.56)	r	0.255	-0.014	0.088	0.037	0.157	0.071
	p	0.199	0.947	0.661	0.853	0.434	0.725
32 (0.59 ± 1.41)	r	-0.111	-0.076	-0.378	-0.485	-0.034	-0.348
	p	0.597	0.718	0.063	0.014*	0.871	0.088
42 (0.57 ± 1.19)	r	0.106	0.177	0.073	0.017	0.219	0.045
	p	0.613	0.398	0.728	0.936	0.293	0.83
22 (1.06 ± 1.73)	r	-0.119	-0.11	-0.172	-0.198	0.002	-0.086
	p	0.555	0.584	0.391	0.322	0.993	0.67
11 (1.25 ± 2.13)	r	0.031	-0.256	-0.042	-0.138	0.047	0.04
	p	0.877	0.189	0.833	0.485	0.813	0.842
31 (0.74 ± 1.42)	r	0.039	-0.269	-0.245	-0.335	0.198	-0.281
	p	0.851	0.194	0.239	0.102	0.343	0.173
41 (0.85 ± 1.44)	r	0.148	0.122	-0.153	-0.278	-0.093	-0.034
	p	0.49	0.569	0.475	0.188	0.664	0.873
21 (1.45 ± 2.45)	r	-0.094	0.134	-0.164	-0.244	-0.018	-0.129
	p	0.633	0.497	0.405	0.212	0.926	0.513

Spearman's rank correlation coefficient, PCS: Pain Catastrophizing Scale, *p<0.05

VAS scores of teeth numbered 15, 13, and 22; PCS helplessness score and VAS score of tooth number 22; PCS magnification score and VAS score of tooth number 22; PCS rumination score and VAS scores of teeth numbered 15, 13, 22, 11, and 21. There were no significant correlations in the other pairings (Table 2).

In the male group, there were statistically significant positive and negative correlations between the following: pressure pain threshold and VAS scores of teeth numbered 35 and 44 (positive correlations); Beck Depression Inventory score and VAS score of tooth number 25; PCS total score and VAS score of tooth number 25; PCS helplessness score and VAS score of tooth number 32; PCS rumination score and VAS score of tooth number 25 (negative correlations). There were no significant correlations in the other pairings (Table 3). For both genders, mean pain scores were higher in the lower anterior region (Tables 2 and 3).

DISCUSSION

Pain is an inherently subjective phenomenon and unfortunately, there is no way to document it objectively at the present time. The most used methods are still subjective tools. Among the subjective methods, VAS is a widely accepted method and it has been stated that it has two significant advantages compared to the others. It provides (1) the freedom to choose the exact intensity of pain and (2) a maximum opportunity for pain expression in an individual style [2]. For these reasons, VAS was used in this study to assess the severity of pain.

In the present study, debonding was always performed at the same time of day, between 10:00 and 14:00. Pöllmann has claimed that the circadian rhythm (diurnal variation) may influence the level of pain [17]. Jones and Chan reported that the pain score peaked in the morning and an overall diurnal variation was found with a tendency to pain increase in the evenings and at night [18]. Similarly, Almuzian et al. stated that the intensity of orthodontic pain fluctuates over the course of a day and the lowest pain intensity is perceived during midday hours [19]. They concluded that researchers should take this factor into account when designing their studies. Therefore, to minimize the effect of circadian rhythm on the results of this study, debonding procedures were performed during midday hours. In addition, since intrusive forces affect pain perception, debonding was performed in an open-mouthed position. In order to avoid confusing the pain perceptions during debonding, the sequence of bracket removal was designed with an interval of 10 seconds between the removal of each bracket.

General outcomes of the present study have shown no remarkable correlation between investigated variables (pressure pain threshold,

Beck Inventory, and Pain Catastrophizing Scores) and debonding pain. In a total of 144 correlation pairings, significant correlations were found in just 11 and 6 pairings in females and males, respectively. No significant correlations were found in the remaining 133 and 138 pairings (Tables 2 and 3). The classical opinion of the literature is that patients who have lower pain thresholds will suffer more from orthodontic pain and there is a correlation between emotional state-stress and perceived pain. We think that there are two possible reasons for the contradiction between classic opinion and the results of our study. (1) Although it is believed that the pain threshold correlates with orthodontic pain, there is no previous study in the literature examining the relationship between them. The established classical view and the fact may not always be the same. (2) While examining individual variables such as gender, age, emotional state-stress, and pain threshold, which were thought to affect orthodontic pain, general conclusions were reached without classification of orthodontic applications. For instance, the results of the studies performed with archwires were interpreted as if they were valid for all types of pain encountered during orthodontic treatment [2,13]. Orthodontic pain is not caused solely by archwire placement, many applications such as separator placement, intermaxillary elastics, and debonding procedure can cause pain. The occurrence mechanisms and individual factors affecting the severity of pain may be different according to the type of procedure. An individual variable acting on the pain that occurred during separator placement may not have an effect on the pain that occurred during debonding, or vice versa.

The pain caused by tooth movement is examined in detail in the literature. The mechanism includes complex inflammatory reactions in the periodontium and dental pulp, and the perception of orthodontic pain has been correlated with the release and presence of various biochemical mediators, such as substance P, histamine, enkephalin, dopamine, serotonin, glycine, glutamate gamma-aminobutyric acid, PGEs, leukotrienes, and cytokines. The release of these chemicals at the site of periodontium requires a relatively long time and it has already been stated that pain starts within two hours after the application of force, gradually increases and reaches peak point between 24 and 36 hours [20]. Whereas, debonding is an instant process and does not last long enough for these complex chemical reactions to occur. Actually, we believe that the characteristics of debonding pain are completely different from the other types of orthodontic pain sourced from archwire activation or separator placement [2,21]. Therefore, we believe that debonding studies should be evaluated separately from other studies and that the results obtained from these studies should not be considered valid for debonding pain.

In this study, the mean VAS scores were found to be less than 1 cm in most of the teeth. In fact, these scores were remarkably less than expected. It was said that the lowest intensity of debonding pain was perceived during midday hours [19]. Since we performed the debonding procedure during these hours, the mean VAS scores might be less than expected. The highest mean VAS scores of both the female and male groups were detected in the lower incisors (Tables 2 and 3). This finding is consistent with the literature. Almuzian et al. stated that tooth type was an important determinant on the level of debonding pain [19]. In many studies, the lower incision region was shown to be significantly more painful [9,22-24]. Almuzian et al. explained this finding with the debonding force per unit surface area of the root as follows: lower incisors are subjected to a greater debonding force per unit surface area of the root. Additionally, the tactile sensory threshold is about 1 g in the lower anterior teeth and gradually increases toward the posterior region. Therefore, more pain is felt in the lower anterior region [19].

CONCLUSION

It was demonstrated, because of the present study, that there were no remarkable correlations between debonding pain and physiologic-emotional states containing pressure pain threshold, depression, and anxiety. For both female and male participants, mean pain scores were higher in the lower anterior region. However, the mean pain scores in most teeth were less than 1 cm.

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