Original Article

Efficacy of different methods to reduce pain during debonding of orthodontic brackets

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ABSTRACT

Objective: To determine pain during debonding and the effects of different pain control methods, gender, and personal traits on the pain experience.

Materials and Methods: Patients who had fixed orthodontic treatment with metal brackets, but no surgical treatment or craniofacial deformity, were included. Sixty-three patients (32 female, aged 17.2 $\pm$ 2.9 years; 31 male aged, 17.2 $\pm$ 2.5 years) were allocated to three groups ($n = 21$) according to the pain control method: finger pressure, elastomeric wafer, or stress relief. Pain experience for each tooth was scored on a visual analogue scale (VAS), and general responses of participants to pain were evaluated by Pain Catastrophizing Scale (PCS). Multiple linear regression analysis, the Mann Whitney *U*-test, and Spearman's rank correlation coefficient analysis were used to analyze the data.

Results: When the VAS scores were adjusted, finger pressure caused a 47% reduction overall, 56% in lower elastomer wafer total, 59% in lower right arch, 62% in lower left, and 62% in lower anterior compared with the elastomeric wafer. In the elastomer wafer group, upper and lower anterior scores were higher than posterior scores, respectively. Females had higher VAS (lower left and anterior) and total PCS scores than males. Regardless of the pain control method, total PCS scores were correlated with total ($r = .254$), upper total ($r = .290$), right ($r = .258$), left ($r = .244$), and posterior ($r = .278$) VAS scores.

Conclusions: The stress relief method showed no difference when compared with the other groups. Finger pressure was more effective than the elastomeric wafer in the lower jaw. Higher pain levels were recorded for the anterior regions with the elastomeric wafer. Females and pain catastrophizers gave higher VAS scores. (*Angle Orthod.* 2016;86:917–924)

KEY WORDS: Pain; Debonding; Fixed appliances; Pain catastrophizing scale

INTRODUCTION

Pain is an important physiological and emotional experience, whose intensity may vary with age, gender, emotional state, cultural background, and previous pain experience.[1–3] Almost 95% of patients undergoing orthodontic treatment have reported varying degrees of pain.[1–4] The association of pain with placement of separators, brackets, and arch wires has been evaluated by previous investigations.[5–7] However, little is known about the presence, causes, or handling of pain during debonding.

The first study about the pain at debonding was done by Williams and Bishara,[8] who found that patients could withstand intrusive forces the most and that there was a positive correlation between tooth mobility and pain threshold. Normando et al.[9] evaluated the degree of pain during debonding with two instruments and found that the lift-off instrument led to almost two times lower levels of pain than wire cutting plier. Mangnall et al.[10] analyzed the effect of soft acrylic bite wafers and reported significantly less pain in the posterior region. Tooth type and expectations of patients about pain also altered their level of discomfort.[10]

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Table 1. Descriptive Statistics About Patient Distribution

	Pain Control Method			
	Finger Pressure	Stress Relief	Elastomeric Wafer	Total
Number	21	21	21	63
Subject				
Males (%)	9 (42.9)	10 (47.6)	12 (57.1)	31 (49.2)
Females (%)	12 (57.1)	11 (52.4)	9 (42.9)	32 (50.8)
Extraction				
Upper jaw only	2	1	2	5
Both jaws	2	5	7	14
No extraction	17	15	12	44
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Age	16.5 ± 1.9	16.6 ± 2.7	18.2 ± 2.7	17.2 ± 2.5
Males	16.8 ± 1.9	16.2 ± 1.9	17.6 ± 1.4	16.9 ± 1.8
Females	16.4 ± 1.9	17.0 ± 3.3	18.8 ± 3.4	17.4 ± 3.1

The results of those studies called attention to the importance of preventive methods, anatomic location, and personal differences in pain experience during debonding. Unfortunately, it is still difficult to draw conclusions about pain-associated factors and methods to handle it. This study aimed to determine the level of pain during debonding and the means of controlling it. Our hypotheses were (1) active pain control methods are favorable to reduce pain at debonding, and (2) patient-related factors such as gender, general pain perception, and anatomic location alter the pain experience.

MATERIALS AND METHODS

The research protocol of this clinical trial was approved by the Gazi University Ethical Committee. The scope of the investigation was explained to the eligible patients and informed consent was obtained. The inclusion criteria were

- patients between 13–21 years of age who could understand, assess, and answer the questionnaires,
- no history of taking medicine periodically or in the last 24 hours (eg, painkillers, corticosteroids, and antiflu drugs),
- no debonded brackets during debonding,
- no missing teeth except extracted premolars,
- undergoing upper and lower fixed orthodontic treatment with Roth prescription 0.018-inch metal brackets having miniature single-mesh base (Victory Series Brackets, 3M Unitek Orthodontic Products, Monrovia, Calif),
- finishing arch wires present for at least two months (0.017 × 0.025-inch stainless steel),
- no surgical treatment (including impacted tooth eruption), no tooth transplantation, and no miniscrews present,
- no craniofacial deformities that would effect dentoalveolar bone quality (eg, cleft lip and palate).

The sample size was determined with the aid of a computer program (PASS 2008 Power Analysis and Sample Size Software, NCSS, LLC Statistical Software, Kaysville, Utah). We calculated that our sample should have a minimum of 19 subjects per group to achieve a power of 80% for a clinically significant difference in mean pain of 13 mm recorded on a visual analogue scale (VAS), with level of significance of $P = .05$.[11]

Three groups were formed according to the pain control method, and participants were randomly allocated to one of them by drawing lots (Table 1):

- Finger pressure group (FP): During debonding of each bracket, operator's finger pressure was applied from the occlusal surface of the tooth in a gingival direction with the thumb. A cotton pad was used under the thumb to eliminate the effect of occlusal morphological variations (Figure 1a).
- Elastomeric wafer group (EW): For each patient, an arch-formed bite raiser from heavy-body silicone impression material (Orthogum C-Silicone Impression Material, Zhermack SPA, Badia Polesine, Italy), approximately 5–6 mm in thickness, was prepared with a smooth surface. It was placed between the arches, and patients were instructed to bite firmly during debonding (Figure 1b).
- Stress relief group (SR): Routine debonding procedures were followed. Patients were instructed to open their mouths and not to occlude. To relieve their stress, they were told that debonding would not cause harm or serious pain (Figure 1c).

The same orthodontist (NCB) interviewed all patients and did the debonding with the same debonding instrument (Direct Bond Metal Bracket Remover, 001-346E, American Orthodontics, Sheboygan, Wisc) using a torquing movement. The arch wire was not removed during debonding. Brackets were debonded one at a time from upper right to upper left, and from

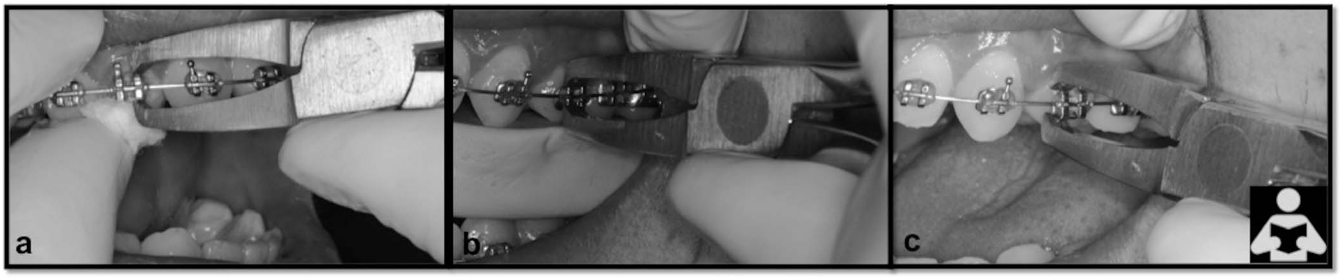

Figure 1. Applied pain control methods: (a) finger pressure, (b) elastomeric wafer, (c) stress relief.

lower right to lower left. A 100-mm VAS was prepared for each tooth, wherein score 0 meant "no pain" and increasing scores from 0 to 100 represented pain increase. Patients were instructed to record their scores on the scale after each bracket was debonded. Extracted premolars and molars were not evaluated for the patients' final score.

Total and quadrant VAS scores were calculated for both jaws. The upper and lower posterior quadrants (UP and LP, respectively) included the canines, first premolars, and second premolars whereas the anterior quadrants (UA and LA) included the central and lateral incisors. The right and left quadrants (UR = upper right, UL= upper left, LR = lower right, and LL = lower left) included the premolars, canines, and incisors of the same region. To prevent any bias, the VAS scores were evaluated by another orthodontist who was blinded to the groups.

To evaluate the connection between personal traits and actual pain at debonding, the general response of participants to any painful situation was assessed by the pain catastrophizing scale (PCS), which consists of 13 statements describing different thoughts and feelings that may be associated with pain. It measures the degree of catastrophizing, which is defined as "an individual's tendency to focus on and exaggerate the threat value of painful stimuli and negatively evaluate one's own ability to deal with pain."[12,13] To avoid any connections with their ratings on PCS and their actual pain experience, patients were asked to complete the questionnaires 1 week after debonding during their routine retainer checks. Patients were instructed to rate each statement on a 5-point scale with verbal anchors of "not at all" at 0 and "all the time" at 4. The PCS was evaluated by the total score and individual scores of three subscales: rumination, magnification, and helplessness.

Statistical Analysis

Statistical analysis was performed using the PASW version 18.0 for Windows (Predictive Analytics Software, SPSS Inc, Chicago, Ill). As the results were not normally distributed, a logarithmic transformation was applied to the VAS scores prior to further analysis. The effect of pain control on VAS scores was analyzed by multiple linear regression analysis with and without adjustments for gender, age, or PCS scores, followed by one-way analysis of covariance. To facilitate interpretation of the multiple linear regression β coefficients, based on a log- transformed outcome, they are reported herein as the percentage difference in pain, using the formula [exponential $(\beta) - 1] \times 100\%$. The effect of anatomic location on each method was analyzed with repeated measure ANOVA, and the difference between genders was evaluated with the Mann-Whitney *U*-test. Correlations between VAS scores and PCS scores were examined by Spearman's rank correlation coefficient. A two-sided *P* value $<.05$ was considered significant for all analyses.

RESULTS

Baseline Data

Descriptive statistics about VAS and PCS scores are given in Table 2. There was no difference between mean age of participants and gender distribution among the groups (Table 1).

Effects of Pain Control Method, Anatomic Location, and Gender

When the scores were not adjusted, none of the pain control methods were superior to one another to reduce VAS scores except in the lower right quadrant. In this quadrant, FP reduced the pain 47% more efficiently than did EW ($P < .05$). However, when VAS scores were adjusted, FP caused 47% reduction in overall ($P < .05$), 56% in LT ($P < .05$), 59% in LR ($P < .01$), 62% in LL ($P < .01$), and 62% in LA ($P < .05$) compared with to (Table 3).

Evaluation of intragroup comparisons for the effect of anatomic location showed that only in the EW, UA, and LA were scores higher than UP and LP, respectively ($P < .05$) (Figure 2). LL ($P < .05$) and LA ($P < .05$) VAS scores were altered by gender, showing that females had significantly higher scores than did males (Table 4).

Table 2. Descriptive Statistics for VAS and PCS Scores

	Pain Control Method			
	Finger Pressure, Median (Range)	Stress Relief, Median (Range)	Elastomeric Wafer, Median (Range)	Total, Median (Range)
VAS Scores				
Total VAS	7 (0–82)	9.1 (0.5–59.1)	12 (1–52.4)	9.7 (0–82)
Upper total (UT)	3.5 (0–36.4)	5 (0–33.1)	6.5 (0–31.7)	5.6 (0–36.4)
Upper right total (UR)	2.5 (0–22.8)	7 (0–38.8)	2.5 (0–36.6)	2.8 (0–38.8)
Upper left total (UL)	1.7 (0–50)	5 (0–33.7)	6 (0–31.8)	5 (0–50)
Upper anterior (UA)	3.8 (0–57.5)	5.8 (0–39.5)	9.9 (0–34.4)	5 (0–57.5)
Upper posterior (UP)	3.8 (0–25)	4.5 (0–33.8)	2.5 (0–31.5)	3.8 (0–33.8)
Lower total (LT)	2.9 (0–45.6)	4 (0–26)	6.7 (0–27)	4 (0–45.6)
Lower right total (LR)	2 (0–36)	4 (0–28)	4.8 (0–27.1)	4 (0–36)
Lower left total (LL)	2 (0–67.6)	3.6 (0–24)	6 (0–32.5)	3.6 (0–67.6)
Lower anterior (LA)	2.5 (0–45)	5 (0–32.5)	8.6 (0–45)	5 (0–45)
Lower posterior (LP)	1.7 (0–46)	2 (0–21.7)	3.3 (0–22.4)	3 (0–46)
PCS Scores				
Rumination	6 (0–14)	6 (0–16)	7 (2–15)	6 (0–16)
Magnification	4 (0–9)	3 (0–10)	4 (0–12)	4 (0–12)
Helplessness	4 (0–20)	5 (0–17)	6 (0–17)	5 (0–20)
Total PCS	14 (0–42)	15 (0–36)	18 (2–40)	16 (0–42)

Effect of Gender on PCS Scores and Correlation of PCS Scores With VAS Scores

Rumination ($P < .05$), helplessness ($P < .01$), and total PCS scores ($P < .05$) of females were significantly higher than male scores (Table 4).

Regardless of the pain control method and gender, total PCS scores were positively and significantly correlated with the total ($r = .254$; $P < .05$), UT ($r = .290$; $P < .05$), UR ($r = .258$; $P < .05$), UL ($r = .244$; $P < .05$) and UP ($r = .278$; $P < .05$) VAS scores. Rumination scores were positively correlated with the total ($r = .288$; $P < .05$), UT ($r = .332$; $P < .01$), UR ($r = .321$; $P < .01$), UL ($r = .247$; $P < .05$), UA ($r = .245$; $P < .05$), and UP ($r = .313$; $P < .05$) VAS scores. Helplessness scores were positively correlated with UT ($r = .263$; $P < .05$), UL ($r = .245$; $P < .05$), and UA ($r = .252$; $P < .05$) VAS scores. When gender was taken into account, PCS scores of females were positively and significantly correlated with VAS scores (Table 5).

DISCUSSION

The results of this study showed that, except for the posterior region, FP was an effective method for pain relief in the lower arch when compared to EW. However, neither FP nor EW were superior to SR in reducing pain during debonding. On the other hand, gender, pain catastrophizing, and anatomic location were found to be the main determinants of pain during debonding. Therefore, our first hypothesis was rejected but our second one was accepted. There are a few articles about pain during debonding but they have some limitations. Williams and Bishara[8] did not actually debond the brackets, while Normando et al.[9] concentrated only on the effectiveness of pliers but did not provide adequate data about the effects of personal traits and gender. On the other hand, Mangnall et al.[10] recorded the pain expectations of participants and their actual experiences during debonding, but the effects of personal traits and gender were not considered. For these reasons, a clinical study evaluating the effects of pain control methods, gender, and anatomic location at the same time was indicated.

Pain experience is very subjective and can show individual variations.[14] The results of our study agreed with previous literature[2,3,6,8,15,16] about the impact of gender on pain (eg, higher VAS scores were recorded for females). Age was also reported to be an important factor in pain perception.[1] For this reason, we determined a limited range and made adjustments for age during statistical analysis to eliminate its effects.

We decided to use PCS developed by Sullivan and colleagues,[12] since pain catastrophizing was shown to be an effective predictor of pain behavior among adults[13] and children.[17,18] Debonding is remarkably shorter than other orthodontic procedures and patients have a limited time to decide. Thus, patients' general pain attitudes could be crucial while giving scores. Thorn et al.[19] stated that when participants are not in pain but are responding to such questionnaires, they make better judgements about what they think in a typical painful situation. For this reason, patients were asked to answer the questionnaires 1 week after debonding to avoid any connections with their ratings on PCS and their actual pain experience.

Pain and discomfort levels due to orthodontic force were examined by various studies in the literature.[1,3,5–7,15,20] It is well documented that compression

Table 3. Effect of Pain Control Method on VAS Scores and Intergroup Differences

	Not Adjusted			Age, Gender, PCS Score Adjusted		
	SR[a]/FP[b]	SR/EW[c]	EW/FP	SR/FP	SR/EW	EW/FP
Overall						
B	−0.22	0.28	−0.50	−0.26	0.34	−0.63
% Difference in pain	−19	32	−39	−23	40	−47
95% Confidence interval	(−57, 49)	(−27, 139)	(−68, 14)	(−58, 42)	(−24, 158)	(−71, −1)
P value	.488	.350	.120	.406	.277	.046*
Upper total						
B	−0.16	0.03	−0.18	−0.20	0.04	−0.19
% Difference in pain	−14	3	−17	−18	4	−17
95% Confidence interval	(−55, 62)	(−44, 89)	(−55, 56)	(−56, 54)	(−45, 97)	(−56, 57)
P value	.627	.932	.560	.526	.892	.554
Upper right total						
B	−0.23	−0.22	−0.01	−0.28	−0.19	−0.10
% Difference in pain	−21	−20	−1	−24	−17	−9
95% Confidence interval	(−60, 57)	(−58, 55)	(−49, 91)	(−61, 48)	(−58, 63)	(−53, 76)
P value	.503	.509	.971	.413	.585	.768
Upper left total						
B	−0.21	0.27	−0.48	−0.26	0.27	−0.47
% Difference in pain	−19	30	−38	−23	31	−38
95% Confidence interval	(−63, 75)	(−38, 174)	(−71, 33)	(−64, 67)	(−40, 185)	(−71, 35)
P value	.586	.478	.215	.507	.489	.225
Upper Anterior						
B	−0.20	0.19	−0.39	−0.23	0.10	−0.30
% Difference in pain	−18	21	−32	−21	11	−26
95% Confidence interval	(−61, 76)	(−41, 151)	(−67, 39)	(−63, 70)	(−49, 138)	(−65, 57)
P value	.609	.595	.282	.541	.791	.427
Upper Posterior						
B	−0.03	−0.21	0.18	−0.08	−0.03	−0.04
% Difference in pain	−3	−19	20	−8	−3	−4
95% Confidence interval	(−50, 90)	(−57, 54)	(−38, 131)	(−50, 73)	(−48, 82)	(−48, 76)
P value	.934	.519	.584	.805	.928	.887
Lower total						
B	−0.09	0.42	−0.51	−0.12	0.56	−0.82
% Difference in pain	−9	52	−40	−11	75	−56
95% Confidence interval	(−52, 74)	(−18, 183)	(−69, 15)	(−53, 67)	(−7, 230)	(−76, −18)
P value	.781	.181	.121	.705	.084	.011*
Lower right total						
B	−0.29	0.34	−0.63	−0.30	0.47	−0.88
% Difference in pain	−25	40	−47	−26	60	−59
95% Confidence interval	(−60, 39)	(−23, 154)	(−71, −2)	(−60, 38)	(−15, 200)	(−78, −22)
P value	.350	.260	.044*	.339	.139	.008**
Lower left total						
B	−0.10	0.51	−0.61	−0.14	0.66	−0.96
% Difference in pain	−10	66	−46	−13	93	−62
95% Confidence interval	(−58, 95)	(−21, 248)	(−75, 19)	(−58, 82)	(−8, 306)	(−81, −23)
P value	.793	.174	.122	.705	.081	.009**
Lower anterior						
B	−0.16	0.48	−0.64	−0.20	0.57	−0.96
% Difference in pain	−15	61	−47	−18	77	−62
95% Confidence interval	(−61, 88)	(−25, 244)	(−75, 14)	(−62, 78)	(−19, 288)	(−82, −20)
P value	.687	.215	.101	.609	.147	.012*
Lower posterior						
B	0.04	0.34	−0.31	0.01	0.50	−0.52
% Difference in pain	4	41	−26	1	64	−41
95% Confidence interval	(−46, 101)	(−25, 165)	(−63, 46)	(−47, 93)	(−15, 215)	(−70, 16)
P value	.906	.280	.373	.978	.135	.125

[a] SR indicates stress relief; [b] FP, finger pressure; [c] EW, elastomeric wafer.
* $P < .05$; ** $P < .01$; *** $P < .001$.

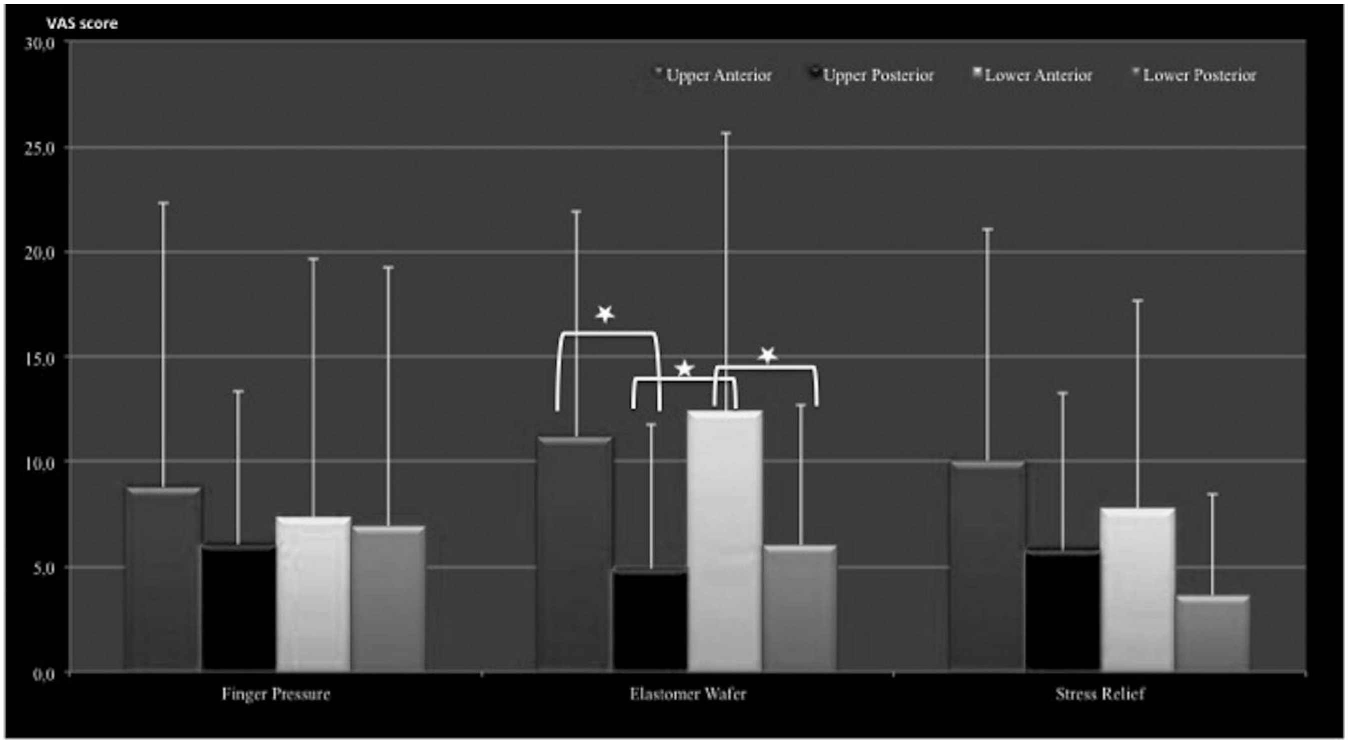

Figure 2. Intragroup comparison of pain relief methods in relation to anatomic location.

of the periodontal ligament (PDL) is of main importance in immediate or initial dental pain.[21,22] At the beginning of treatment, patients are not used to the feeling of PDL changes and when it combines with changes in the concentration of biological mediators, the patients experience high levels of pain. We observed that mean VAS scores during debonding were lower than those reported for other orthodontic procedures.[6,7,20] In the present study, the median total VAS scores of groups were between 7 and 12. Mangnall et al.[10] reported median VAS scores of 25.9 and 33.6 for control and wafer groups, respectively. Normando et al.[9] reported that the most frequent scores were 0 and 1 on a scale of 0 to 4, and for only 5 teeth out of 342, participants gave a score of 4 (intolerable pain). This difference could be due to biological pathways to compensate pain but it could also be the result of "getting used to it" by the help of past experiences stored in the cerebral cortex.[23]

Previous studies have reported that the most tolerable force application during debonding was intrusion, which can even reduce pain.[8,10,24] In our study, neither FP nor EW, which were designed to evaluate the effect of intrusive forces, were better than SR. However, the overall and lower (mandibular) arch scores—except LP—were reduced in FP compared with EW, which may demonstrate the effectiveness of intrusive force applied directly on the tooth. Similarly, Mangnall et al.[10] showed that biting a soft acrylic wafer reduced pain in the posterior teeth only. However, there is no data about how much of a decrease in the VAS scale can be called "clinically successful" for orthodontic applications. Todd[11] states that for children between 5 and 16 years with acute pain, a method enabling a 13-mm reduction on a 100-

Table 4. Effect of Gender on VAS and PCS Scores

	Median (Range)		
Scores	Male	Female	P
VAS scores			
Overall	8.7 (0–47.3)	12.7 (0–82.0)	.067
Upper total	3.1 (0–20.3)	6.4 (0–36.4)	.249
Upper right total	2.6 (0–17.8)	3.2 (0–38.8)	.805
Upper left total	2.5 (0–26.1)	7.6 (0–50.0)	.130
Upper anterior	5.0 (0–34.4)	5.7 (0–57.5)	.353
Upper posterior	3.8 (0–11.7)	3.5 (0–33.8)	.312
Lower total	3.4 (0–27.0)	5.6 (0–45.6)	.086
Lower right total	4.0 (0–30.0)	4.0 (0–36.0)	.574
Lower left total	2.0 (0–26.9)	5.4 (0–67.6)	.010*
Lower anterior	2.5 (0–32.8)	7.8 (0–45.0)	.024*
Lower posterior	1.7 (0–22.4)	2.7 (0–46.0)	.256
PCS scores			
Rumination	5.0 (0–15.0)	7.5 (0–16.0)	.021*
Magnification	3.0 (0–12.0)	4.0 (0–10.0)	.990
Helplessness	4.0 (0–17.0)	6.0 (0–20.0)	.009**
Total PCS	13.0 (0–40.0)	18.5 (0–42.0)	.044*

* $P < .05$; ** $P < .01$.

Table 5. Correlations of Component and Total Scores of PCS With VAS Scores

	Rumination			Magnification			Helplessness			Total PCS		
VAS Scores	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Total	0.138	0.278	0.288*	−0.016	0.375*	0.183	0.193	0.173	0.234	0.104	0.285	0.254*
Upper total (UT)	0.224	0.341*	0.332**	−0.048	0.395*	0.200	0.201	0.221	0.263*	0.145	0.349*	0.290*
Upper right total (UR)	0.271	0.352*	0.321**	0.005	0.324	–	–	0.172	0.167	0.168	0.340*	0.258*
Upper left total (UL)	0.090	0.275	0.247*	−0.041	0.347*	0.174	0.159	0.185	0.245*	0.063	0.297	0.244*
Upper anterior (UA)	0.176	0.243	0.245*	−0.042	0.345*	0.164	0.191	0.217	0.25*	0.093	0.276	0.225
Upper posterior (UP)	0.131	0.388*	0.313*	−0.056	0.329	0.174	0.107	0.250	0.224	0.097	0.380*	0.278*
Lower total (LT)	−0.009	0.109	0.144	−0.053	0.182	0.060	0.060	0.010	0.090	−0.025	0.092	0.107
Lower right total (LR)	0.175	−0.059	0.072	0.026	−0.010	−0.003	0.106	−0.101	0.004	0.116	−0.091	0.027
Lower left total (LL)	0.137	0.124	–	−0.135	0.215	0.031	−0.019	0.067	0.119	−0.154	0.142	0.100
Lower anterior (LA)	0.181	0.232	–	0.204	0.059	–	0.099	0.023	0.137	0.014	0.131	0.161
Lower posterior (LP)	−0.209	0.135	0.071	−0.046	0.268	0.121	−0.044	0.095	0.110	−0.149	0.163	0.100

* Significant correlation at $P < .05$ level; ** significant correlation at $P < .01$ level.

mm VAS can be accepted as clinically relevant. If this is taken into account, none of the active force applications used in our study can be considered workable. Still, FP can be an effective and easy method of pain control, particularly in the lower arch, since it is economical and needs less chair time. On the other hand, SR should be taken seriously by orthodontists because it implies that patients who trust their doctors would be more comfortable during orthodontic force applications.

Anatomic location is an important determinant for the degree of pain caused by orthodontic forces. In practice, most orthodontists are aware that the upper and lower anteriors are very sensitive to the force of debonding. As if to verify this clinical observation, our results demonstrated significant differences between the anterior and posterior regions, and higher VAS scores were given for the anterior regions in all groups, but it was significant only in the EW group. Normando et al.[9] mentioned that the patients in their cohort reported intolerable pain mostly in the maxillary central and lateral and mandibular central incisors. In the Mangnall et al. study,[10] 39% of patients reported that the most painful section during debonding was the lower anterior region. Bearing these in mind, we can hold the anatomic region and root morphology responsible for the pain experience.

Our results have demonstrated relatively low but significant correlations between total VAS and PCS scores. Reducing pain or discomfort in every individual receiving orthodontic treatment is one of our main concerns, so that any significant correlations should be taken into account seriously. According to this perspective, total PCS and rumination subscale scores were correlated with VAS scores of the upper arch, where debonding started. Being unable to find any correlations with the lower arch can be explained by the "monotony factor." Williams and Bishara[8] defined this term to explain why patients can lose interest in the procedure after the first few teeth are debonded.

The dominance of the ruminitive component in this study may influence clinicians to focus on thought-stopping strategies.[19] Brain MRI studies have shown that expectations of pain interact powerfully with brain mechanisms that alter the subjective pain experience, enabling positive expectations to reduce perceived pain by 28.4%.[25] Supporting this finding, Polat[22] mentioned that informing the patient and putting their trust in their doctors would help control the anxiety. How SR worked as well as FR and EW in this study might also support those findings. Correlations of VAS scores with rumination, magnification, and total PCS scores in females should also be kept in mind when communicating with female patients.

This study has some limitations. Molars were not evaluated because attachments thereon may vary according to patients' treatment needs and orthodontists' preference. Patients' attitudes toward pain can also depend on varied conditions such as using different hand instruments at debonding, cultural background, and practitioner's experience. Still, our results imply that differences in gender and personal traits might be useful in understanding patients' reactions to debonding.

CONCLUSIONS

- Finger pressure was more effective than the elastomeric wafer regarding pain experience during debonding, especially for the lower jaw, but neither was superior to stress relief.
- Upper and lower anterior teeth are more sensitive to pain than posterior teeth during debonding with the elastomeric wafer.
- Females and pain catastrophizers tend to report higher pain levels.

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