Efficacy of Different Methods in Reducing Pain Post Orthodontic Debonding

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**Abstract:** Orthodontic pain often arises due to increased pressure, swelling, inflammation, and ischemia at the periodontal level. Approximately 95% of patients undergoing orthodontic treatment report experiencing mild to severe pain or discomfort during or after various orthodontic procedures. However, the perception of pain and the methods used to alleviate it during debonding remain inadequately explored, particularly in relation to factors such as gender and different regions of the oral cavity. Several approaches, including medications, adjunctive protocols, and specific debonding tools, aim to reduce pain or distress during the fixed appliance debonding procedure.Pain intensity was measured immediately after debonding using a Visual Analog Scale (VAS). Statistical analysis was performed using SPSS software. The medication group (Paracetamol + Ibuprofen) showed the lowest VAS scores, indicating the most effective pain reduction. The finger pressure group experienced moderate pain levels, while the stress relief group reported the highest pain scores. A Pearson correlation test was conducted, yielding a p-value of 0.046, which is statistically significant. The use of oral analgesics, specifically Paracetamol and Ibuprofen, proved to be the most effective method for managing pain during orthodontic debonding procedures. These findings suggest that medications can be reliably employed to alleviate discomfort during debonding.

**keywords:** psychological, Transcutaneous Electrical Nerve Stimulation, vibratory stimulation of the Periodontal Ligament, Non-Steroidal Anti-Inflammatory Drugs

# Introduction

Pain is the unpleasant sensation experienced during injury or illness. It is a significant emotional and physiological experience, where its intensity may vary depending on factors like age, emotional state, anxiety levels, gender, and prior pain experiences (Aparna, Maiti, & Jessy, 2021). Pain is understood as a subjective response, showing considerable individual differences (Ganapathy, 2021). Defining the exact need for orthodontic treatment is challenging, as the functional and psychological benefits are often unclear. In modern times, patients seeking orthodontic treatment primarily do so for aesthetic purposes, although functional issues related to malocclusion may also play a role. This indicates that the demand for orthodontic procedures is more often driven by psychological or socio-psychological factors rather than purely physical reasons. Immediate treatment is typically necessary only for significant malocclusions, while many decisions regarding orthodontic treatment involve discussions between the patient, the dentist, the orthodontist, and occasionally the payment agency (Verma & Muthuswamy Pandian, 2021). The goal of orthodontic treatment is to enhance cosmetic appearance, which in turn can improve an individual's social acceptance and self-esteem (Poornima et al., 2021; Verma & Muthuswamy Pandian, 2021).Orthodontic pain arises from increased pressure, inflammation, swelling, and ischemia at the periodontal level. These factors activate intracellular elements like histamine, prostaglandins (PGs), Substance P, and Bradykinin, leading to immediate or delayed hyperalgesic pain in the affected tooth or region (Ganapathy, 2022). On average, about 95% of orthodontic patients experience varying degrees of pain or discomfort during or after certain orthodontic procedures. Common procedures that cause pain include the use of separators, miniscrew insertion, archwire activation, and debonding of fixed appliances. Several strategies are available to alleviate pain or discomfort during the removal of fixed appliances, including the use of analgesics, adjunctive protocols, and specialized debonding tools. However, the perception of pain and its management during debonding, with respect to gender and different areas of the oral cavity, remains underexplored in orthodontics (Merchant, Ganapathy & Maiti, 2022).Pain experienced during debonding of orthodontic treatments can be reduced using various methods, such as finger pressure, elastomeric wafers, and stress-relief techniques (Chokkattu et al., 2022). Additional approaches include the use of analgesics, anesthetics, low-level laser therapy for periodontal tissues, vibratory stimulation of the Periodontal Ligament (PDL), Transcutaneous Electrical Nerve Stimulation (TENS), and Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), although the latter is the least recommended for pain relief during the removal of fixed orthodontic appliances (Ramamurthy et al., 2022). In the finger pressure technique, the operator applies pressure to the occlusal surface of the tooth with their thumb, sometimes using a cotton pad to account for variations in occlusal morphology (Marya et al., 2022). The elastomeric wafer method involves using heavy-body silicone impression material to create an arch-formed bite raiser, which patients are instructed to bite during appliance removal. Additionally, stress relief techniques often involve psychological counseling to reassure patients that debonding will not cause harm. Systematic reviews evaluating the effectiveness of various protocols to reduce pain during orthodontic treatment and debonding show a lack of consensus among orthodontists on the most effective methods (Jain & Verma, 2022). Therefore, the aim of the present study is to assess the effectiveness of different techniques in reducing pain during post-orthodontic debonding.

# Materials and methods

## Study Design

This study employed a cohort design and was conducted in Chennai. Data for this study were obtained through a comprehensive review of patient records and the analysis of patient data collected between June 2022 and February 2023.

## Participants

The study included a total of 40 participants, ranging in age from 13 to 29 years. Inclusion criteria for participants required that they were capable of comprehending, assessing, and responding to study inquiries. Additionally, participants were required to meet specific eligibility criteria, including:

* Not currently using any medication that could influence pain perception.
* The absence of debonded brackets during the debonding procedure.
* No history of surgical treatment related to the orthodontic procedure.
* No recent tooth transplantation.
* The absence of miniscrews or any other orthodontic devices.
* No missing teeth except for extracted premolars.

## Pain Assessment

Pain assessment in this study utilized the Visual Analog Scale (VAS), a widely accepted pain rating scale. Participants were asked to mark a 10cm line that ranged from "no pain" to "worst pain" to indicate their perceived pain level. The VAS scores obtained in this study were subjected to statistical analysis, with a predetermined level of significance set at P<0.05.

## Group Allocation

To investigate the effectiveness of different pain management methods, participants were randomly assigned to one of four groups:

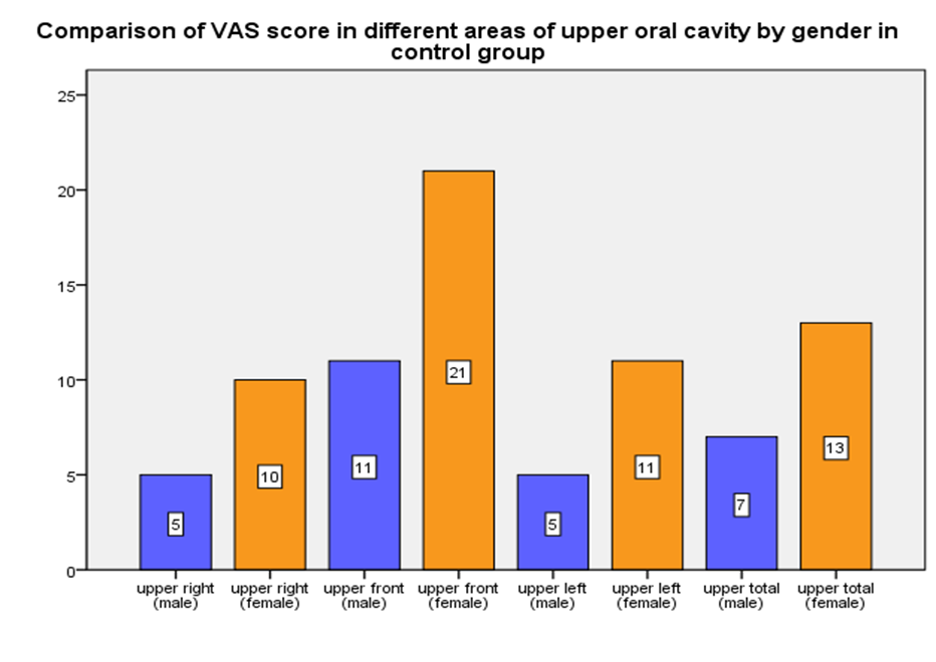
* Group A: Medication group, where patients took 500mg of Paracetamol one hour prior to the debonding procedure.
* Group B: Finger pressure group.
* Group C: Stress relief group.
* Group D: Control group, where no specific pain-reducing methods were employed.

## Data Collection and Analysis

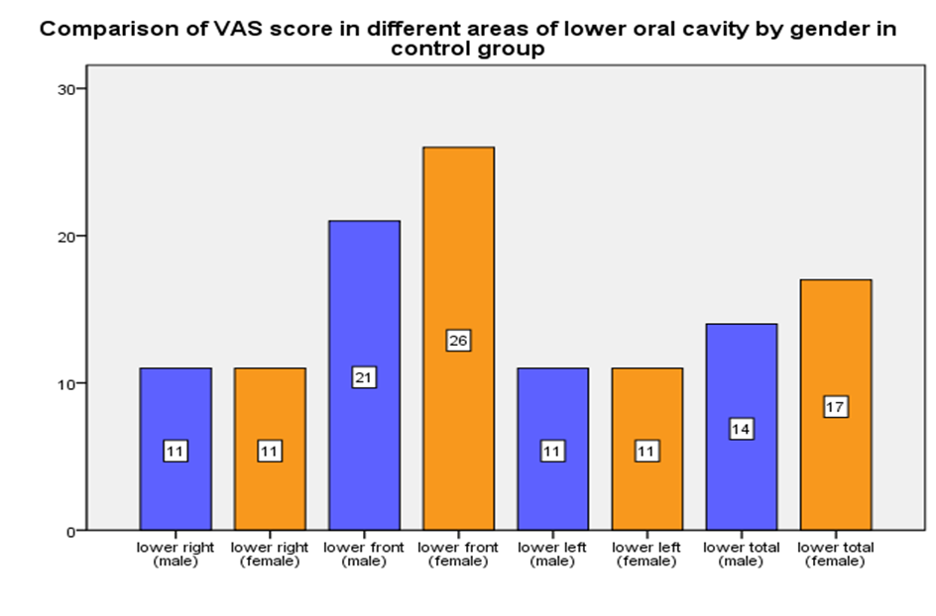
Data obtained from the study participants were meticulously recorded and subsequently transferred to Microsoft Excel version 2013. To ensure data integrity and accuracy, data authentication procedures were carried out. The statistical analysis was performed using IBM SPSS Statistics version 23, with a significance level set at P<0.05. Descriptive analysis was conducted to summarize the data, and categorical data analyses were performed using the chi-square test.

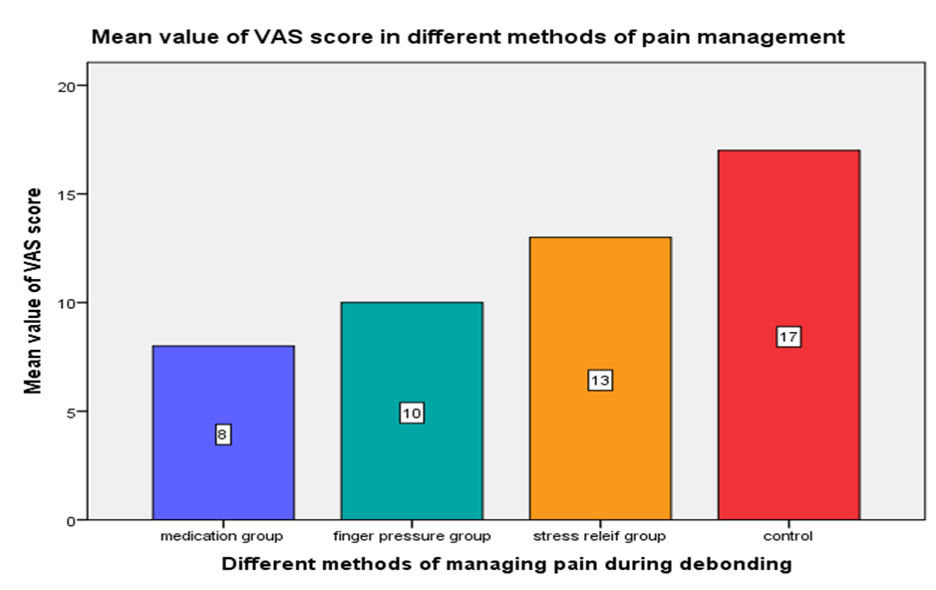
# Results

The first two figures of the current study represents the estimation of level of pain observed in different anatomical sites of the oral cavity with respect to gender of the control group, that was evaluated using VAS (Visual Analogue Scale). Figure 3 represents the efficiency of different methods used on the debonding orthodontic patients to reduce pain. They include the medication group, finger pressure group, stress relief group and the control. One way ANOVA test and Mann-Whitney tests have been conducted to compare the VAS score observed in different areas of oral cavity in accordance with various pain reducing methods and within gender. The highest VAS score was observed in the control group and stress relief group followed by the finger pressure group and medication group. The highest VAS score recorded region in both male and female is lower front tooth region which has statistically significance.



**Figure 1:** Comparison of VAS score in different areas of the upper oral cavity during debonding procedure in accordance to the gender of the control group. Female population has experienced more pain than male. The highest pain perception has been observed on the upper front tooth region for both male and females.



**Figure 2:** Comparison of VAS score in different areas of the lower oral cavity during debonding procedure in accordance with the gender of the control group. Female population has experienced more pain than male. The highest pain perception has been observed on the lower front tooth region for both male and females. 

**Figure 3:** Distribution of mean VAS score in different methods of pain management. The lowest Vas score has been observed in the medication group (Paracetamol + ibuprofen) taken before 1 hour of debonding procedure, followed by finger pressure group and then by stress relief group. Pearson correlation tests have been conducted with a *p* value of 0.046 which is statistically significant.\**p* value <0.05 is taken as significant.

**Table 1**: *p* value <0.05 is taken as significant

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Areas of oral cavity** | **Median VAS score of the groups** | | | | ***p* value** |
| **Medication group** | **Finger pressure group** | **Stress relief group** | **Control group** |
| Upper right | 5 | 5 | 10 | 10 | 0.030\* |
| Upper left | 5 | 5 | 10 | 10 | 0.020\* |
| Upper front | 10 | 15 | 15 | 15 | 0.026\* |
| Upper total | 6.67 | 8.33 | 11.66 | 11.66 | 0.018\* |
| Lower right | 5 | 10 | 5 | 10 | 0.025\* |
| Lower left | 5 | 10 | 5 | 10 | 0.036\* |
| Lower front | 15 | 15 | 20 | 15 | 0.042\* |
| Total | 8 | 8 | 13.33 | 13.33 | 0.029\* |

**Table 1:** One way ANOVA test conducted using Visual Analog Scale (VAS) in different areas of oral cavity in accordance with various pain reducing modalities. The highest median VAS score was observed in both the control and stress relief group (13.33) followed by the finger pressure and medication group (8). The anterior upper and lower areas of the oral cavity showed the highest median VAS score despite the group.

**Table 2:** *p* value <0.05 is taken as significant

|  |  |  |  |
| --- | --- | --- | --- |
| Areas of oral cavity | Median VAS score | | *p* value |
| Male | female |
| Upper right | 5 | 5 | 0.354 |
| Upper left | 5 | 10 | 0.267 |
| Upper front | 10 | 20 | 0.182 |
| Upper total | 6.67 | 11.66 | 0.781 |
| Lower right | 10 | 10 | 0.523 |
| Lower left | 5 | 20 | 0.457 |
| Lower front | 20 | 30 | 0.012\* |
| Lower total | 11.66 | 20 | 0.284 |
| Total | 10 | 20 | 0.346 |

**Table 2:** Mann-Whitney test conducted for the comparison of VAS score in different areas of oral cavity in accordance with gender. The highest VAS score observed in both genders is in the lower front tooth region which is found to be statistically significant. The highest VAS score of females in the lower front tooth region is 30 while for male it is 20 respectively.

# Discussion

Several studies have explored effective ways to reduce pain during post-orthodontic treatment (Brown and Moerenhout, 1991; Ngan, Kess, and Wilson, 1989; Chow and Cioffi, 2018). Pain management has become a significant concern for patients undergoing orthodontic procedures (Wadhwani, Sivaswamy, and Rajaraman, 2022). Regardless of the pain-reduction techniques employed, the primary goal during debonding procedures is to use the proper debonding instruments without causing reversible or irreversible damage to the tooth or its surrounding structures(Rafi et al., 2024). The current study aimed to assess pain perception at different anatomical sites within the oral cavity, particularly in the control group, with respect to gender and the effectiveness of each method for reducing pain during debonding (Sreevarun et al., 2023).

The results revealed that females generally reported higher pain levels during the debonding procedure compared to males. Among both genders, the upper front tooth region in the upper oral cavity was more prone to pain in the control group (Solanki et al., 2023). This finding is consistent with previous research by Normando et al., which noted significantly higher pain perception in the anterior regions of both the maxillary and mandibular teeth compared to the posterior teeth during debonding (EBSCOhost, no date). Similar gender differences in pain perception were observed in the lower oral cavity, where females also reported more pain or distress compared to males, reflecting the findings in the upper oral cavity (Muthuswamy Pandian et al., 2022; Chokkattu, Neeharika, and Rameshkrishnan, 2023). The lower front tooth region was identified as the most painful area for both females and males.

Studies by Bavbeck et al. also demonstrated that females had a significantly higher pain or discomfort perception during orthodontic debonding procedures than males, which aligns with the current study's findings (Anti-inflammatory Potential Mouthwash Formulated Using Clove Ginger Mediated Zinc Oxide Nanoparticles: Vitro Study, no date). Similarly, Almuzian et al. (2013) found that females reported higher VAS scores than males. Mangnall et al. (2013) further highlighted that the lower anterior sextant (Sextant 5) was the most painful during debonding procedures (Laghari et al., 2023), a result corroborated by Normando et al. (2010), who also noted higher pain in the maxillary and mandibular central and lateral incisors (Adel, El-Harouni, and Vaid, 2023). These studies support the findings of the present research.

William O.L. proposed that pain during the debonding of orthodontic brackets could be attributed to the shear/peel effect on the periodontal ligament. This discomfort might be alleviated by applying intrusive or torsional forces to stabilize the tooth, which could reduce pain by providing proprioceptive stimuli (Subramanian and Harikrishnan, 2023). The present study also examined various pain-reduction techniques used during debonding (P<0.05). The medication group, which received 500 mg of paracetamol one hour before the procedure, reported the least pain (Tuluwengjiang et al., 2024). The second most effective method was the application of finger pressure, where the dentist’s thumb was placed vertically along the long axis of the tooth being debonded, with a cotton pad placed between the tooth and the finger. This method was consistent with previous research, which showed that taking oral analgesics (paracetamol + ibuprofen) one hour prior to debonding reduced pain by 72% compared to the control group. The VAS scores in the medication group were lower than those in the control group.

In addition, Bavbeck et al. found that the application of finger pressure reduced pain more effectively than using elastomeric wafers, which apply intrusive forces to the teeth. Kraut et al. (1991) investigated the use of thermal devices to decrease pain during debonding procedures. The heat generated by these devices softens the adhesive material beneath the bracket, which in turn reduces pain compared to conventional mechanical debonding methods. However, one drawback of thermal devices is the potential for reversible or irreversible pulpal damage. Despite this, in vitro and histopathological studies have shown that the use of thermal devices is relatively safe. Khan et al. (2015) also found that ultrasonic scalers could reduce pain during debonding by generating tensile forces on the bracket after creating a luxation point beneath it, which produces an intrusive force. This technique was reported to cause less pain compared to using bracket removal pliers.

# Conclusion

The current study indicates that both the upper and lower anterior tooth regions of the oral cavity are more susceptible to pain during orthodontic debonding compared to the posterior regions, regardless of gender. Additionally, females reported higher levels of pain than males. The administration of 500 mg of paracetamol one hour prior to the debonding procedure proved to be more effective in reducing pain compared to the finger pressure technique and other stress relief methods. The techniques explored in this study were shown to significantly reduce pain and discomfort during the post-orthodontic treatment phase. However, future research should incorporate high-quality methods and advanced technological approaches with larger sample sizes to further enhance pain management in post-orthodontic treatment procedures.

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