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Orthodontic Pain Perceived by Orthodontic Patient Under Active Orthodontic Treatment at Alignment Stage

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Abstract: ***Objective**: We assessed the type, level, duration, and position of pain for patients who received orthodontic treatment with respect to gender, crowded teeth, pain triggers, tooth extraction, and medical treatment. **Methods**: We considered a sample of 188 patients from the Jordanian population who received orthodontic treatment. We collected the data from the Hakeem system database. We analysed the data with Student's t - test, analysis of variance, and Pearsons' chi - square test. **Results**: Tooth crowding and extraction did not have a significant impact on the level of pain. We found that 64.3% of pain triggers were due to chewing and biting. Besides, most of the subjects experienced pain within the first couple of days of treatment; it could last for up to 5 days. Moreover, tooth crowding and higher pain levels were more common in women. Finally, the most common type of pain was due to pressure caused by tightening dental braces. **Conclusion**: This study sheds light on the type, level, duration, and position of perceived pain during orthodontic treatment. Chewing and biting were the most common pain triggers, and this pain was mainly perceived at the anterior and posterior teeth. While women noticed crowding a bit more than men, it did not contribute to higher pain. However, extractions seem to be more common in subjects with tooth crowding.*

Keywords: Orthodontic treatment; Perceived pain; Pain triggers; Pain locations

1. Introduction

Orthodontic therapy can cause a variety of pain types and discomforts that may be noticed at different stages while rectifying bite and dental alignment problems. One of the most prevalent issues is gum and tooth pain, especially in the early stages following orthodontic therapy. The pressure that is applied to the teeth to move them into appropriate alignment is usually the cause of this discomfort. As the mouth acclimates to the new location of teeth, gum and tooth pain often goes away in a few days and may lead to a sense of discomfort or soreness. Tightening or adjusting braces during the treatment period is another orthodontic - treatment - related source of discomfort. This can result in a more acute and sharper pain, particularly in the initial days following the adjustments as the teeth reposition.

The type of orthodontic treatment might affect the location of discomfort. For example, conventional braces may cause discomfort predominantly at the gum line and around the brackets and wires. In general, orthodontic pain is typically manageable with over - the - counter analgesics and orthodontic wax to reduce irritation related to braces. Moreover, a patient can stick to softer foods when they feel pain or discomfort. To guarantee that the treatment plan is appropriately adjusted, any severe or chronic discomfort should also be discussed with the orthodontist as soon as possible.

There are several potential pain triggers, including chewing and biting, cold foods and liquids, hot foods and liquids, and physical activity. Chewing and biting can increase pain during orthodontic treatment, particularly after modifications. This is due to the fact that the pressure these activities place on the teeth can lead to pain, especially if the teeth are still getting used to their new locations. To reduce the strain on the teeth during chewing, patients may find it more pleasant to stick to softer foods or to chop food into smaller pieces.

Following orthodontic treatment, sensitivity to cold temperatures is normal, particularly in the case of braces. Because brackets and wires may more easily transfer temperature changes to the teeth, the teeth may feel more sensitive to cold meals or beverages. When eating cold food, patients may feel pain or discomfort for a short time, but this sensitivity usually goes away as the teeth get used to the orthodontic equipment. Hot meals or beverages may also create discomfort following orthodontic treatment. If there is any inflammation or irritation from the orthodontic equipment, the heat might make teeth and gums more sensitive. To reduce discomfort until any sensitivity goes away, patients may decide to eat and drink lukewarm or room - temperature foods and beverages. Another reason for sensitivity to different temperatures is pulp hypersensitivity, which describes the increased sensitivity or pain people may feel when the dental pulp (the tooth's deepest layer that contains blood vessels and nerves) gets inflamed or exposed. Dental cavities, trauma, or dental operations like scaling or drilling can cause this phenomenon. Patients with

hypersensitive pulp may be sensitive to cold air, hot or cold foods, and/or sweet or acidic substances, which can cause abrupt, acute pain or discomfort. Generally, the pulp is extremely sensitive to outside stimuli, which causes an exaggerated pain response and sensitivity.

Exercising, particularly when engaging in activities that require impact or jarring motions, may make discomfort following orthodontic treatment worse. The vibrations and pressures applied to the teeth and jaw during physical activity may enhance sensitivity and pain, especially during the early phases of therapy or following modifications. Wearing a mouthguard during specific activities might be beneficial for patients as it offers extra protection and lowers the possibility of discomfort or damage.
We aimed to explore the intricate interplay between pain triggers, pain locations, gender differences, and the influence of tooth crowding and extraction on pain perception in patients who received orthodontic treatment. We sought to provide a comprehensive understanding of the complex relationship between perceived pain and orthodontic procedures in a selected sample of the Jordanian population.

2. Literature Review

While orthodontic treatment is necessary to rectify dental misalignments, patients frequently experience pain and discomfort during the procedure. It is essential to comprehend the causes and nature of this pain to enhance patient satisfaction and treatment results. Pain is a common aspect of various medical procedures, including orthodontic treatment, which is often perceived as painful by a significant portion of the population (Raja et al., 2020). The fear of experiencing pain serves as a significant deterrent for individuals considering orthodontic treatment as it contributes to treatment discontinuation (Mangnall et al., 2013). Moreover, the level of discomfort experienced after orthodontic aligner placement may indicate the patients' willingness to adhere to treatment, with those experiencing less discomfort being more compliant (Tuncer et al., 2011; Long et al., 2013). Assessing orthodontic pain typically relies on a visual analogue scale (VAS), which is known for its reliability and sensitivity; however, its subjective nature limits its utility (Karobari et al., 2021).

The most widely prescribed treatment for pain management is over - the - counter analgesics, primarily nonsteroidal anti - inflammatory drugs (de Aguiar et al., 2017). The overuse of these drugs and their possible side effects during endodontic and orthodontic treatments are causes for concern. Each year, these issues affect around 3% of the population, and they can have major side effects like bleeding, stomach perforation, and peptic ulcers that frequently require additional medical care (Yuvashree et al., 2023). Many facets of the discomfort that patients report during orthodontic treatment have been clarified by recent research. For example, Cheng et al. (2020) emphasised the importance of pain triggers and found that biting and chewing are the main causes of discomfort. Thus, it is crucial to consider functional activities when determining pain thresholds.

There has also been a great deal of research on the site of discomfort during orthodontic treatment. According to Canigur et al. (2022), anterior and posterior teeth are where most people experience pain. Hence, these teeth need to be the focus of specific pain management techniques. Recent work has also focused on the gender - related disparities in pain perceptions. Jawaid et al. (2020) and Abu Alhaija et al. (2015) revealed that women have varying pain thresholds and typically feel somewhat greater levels of pain than men. These findings highlight the necessity of gender - specific pain management strategies in orthodontic treatment.

Additionally, a number of studies have looked into the connection between dental crowding and discomfort. According to Noviantini et al. (2020), crowding may be more common in women, but this does not always mean that they experience greater discomfort. However, Keshavarz et al. (2019) suggested that extraction processes in circumstances of acute crowding may affect how people perceive pain.

New developments in pain management treatments have resulted from advances in orthodontic technology and practices. In a recent meta - analysis, Deana et al. (2017) found that the use of low - level laser treatment has shown the potential in decreasing orthodontic discomfort. These kinds of treatments provide opportunities to improve the comfort of patients while they receive orthodontic care.

To summarise, the current research has emphasised the complex relationship between pain felt during orthodontic treatment and a variety of parameters, including pain triggers, locations, gender disparities, and the impact of crowding and extraction of teeth. Orthodontists can customise treatment plans to reduce pain and to improve patient outcomes by using these findings in their clinical practice.

3. Methods

The Research Ethics Committee of the Jordanian Royal Medical Services provided ethical approval for this study. It was performed within the dental department facilities of the Jordanian Royal Medical Services.

In this study, 188 patients (11–29 years old) were surveyed after receiving orthodontic treatment for the purpose of studying different factors and facets that may result as a consequence of therapy. These encompassed a wide array of parameters including the nature of tooth crowding, instances of extraction, pain triggers, specific pain locations, the types of pain experienced, the intensity of pain, the onset and duration of pain episodes, as well as the efficacy of medication in mitigating the pain duration and intensity. The inclusion criteria were: aged 11–29 years; both males and females; had received orthodontic treatment for malocclusion, spacing, crowding, protrusion, impacted teeth, midline discrepancy, and/or jaw growth discrepancies; and provided informed consent to take part in the study. The exclusion criteria were: insufficient bone density; uncontrolled bruxism; severe systemic health conditions; diabetes; and a history of trauma or surgical procedures in the past 12 months.

Figure 1 shows the methodological steps followed in this study. This approach was followed to reduce bias, to improve repeatability, and to ensure the authenticity and dependability

of the study results. First, the objective of this study was identified: to examine various elements and aspects that could arise following orthodontic treatment, including the degree of tooth crowding, extractions, factors that trigger pain, precise pain locations, the types and intensity levels of pain experienced, the initiation and duration of pain episodes, and the effectiveness of medication in reducing pain duration and severity. Second, the target population was identified according to the inclusion and exclusion criteria. Third, the survey was carefully designed to develop clear, concise, and unbiased questions that align with the objective. Fourth, the Hakeem system database, which is incorporated in the Royal Medical Services to keep patient records, was used to collect data. Fifth, the data collection was monitored to guarantee accuracy and completeness. In addition, measures to minimise respondent bias and missing values were followed. Sixth, data analysis employed Student's t - test, one - way analysis of variance (ANOVA), and Pearson's chi - square test. Note that there were some missing values in the data set. In addition, outliers were identified based on a specific test and subsequently excluded from the study. SPSS Statistics version 17 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Seventh, the results were interpreted and discussed. Finally, this manuscript presents the findings.

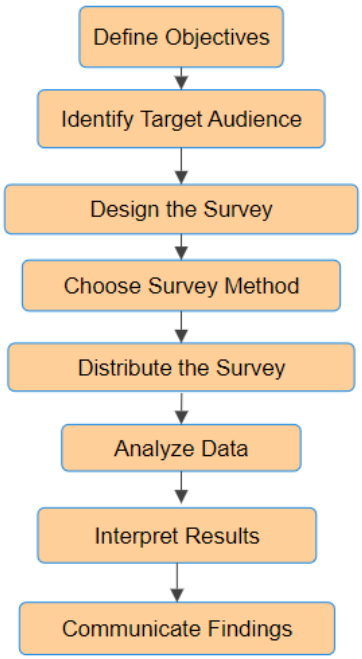
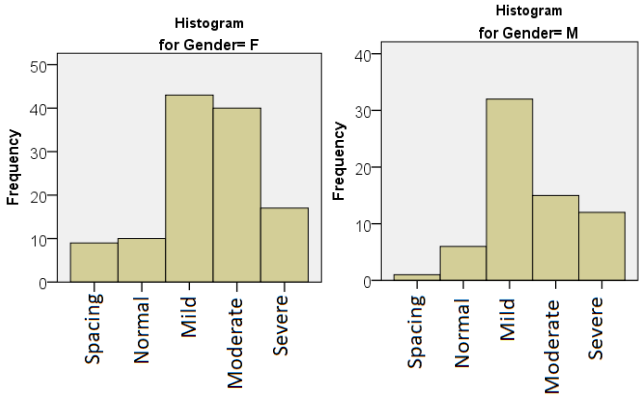


Figure 1: The methodological steps of this study.

4. Results

Figure 2 shows the frequency of tooth crowding patterns in the female and male participants. In both genders, mild tooth crowding was most prominent.



(a) (b)

Figure 2: Frequency of tooth crowding patterns for the (a) female and (b) male patients in the sample.

Figure 3 shows that extraction increased as the severity of tooth crowding increased (see the green bars). Clearly, patients with severe crowding underwent extractions more frequently.

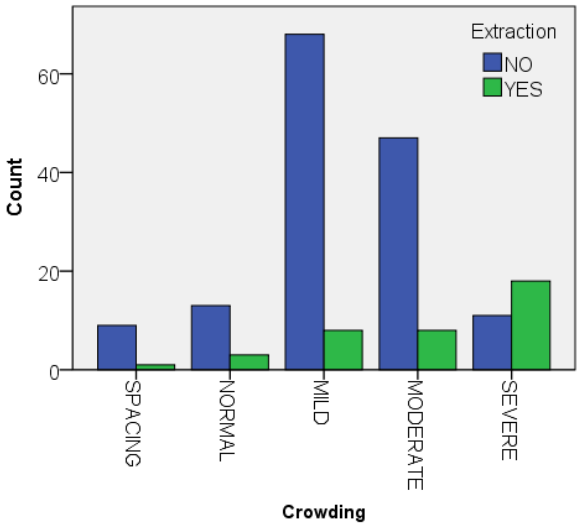
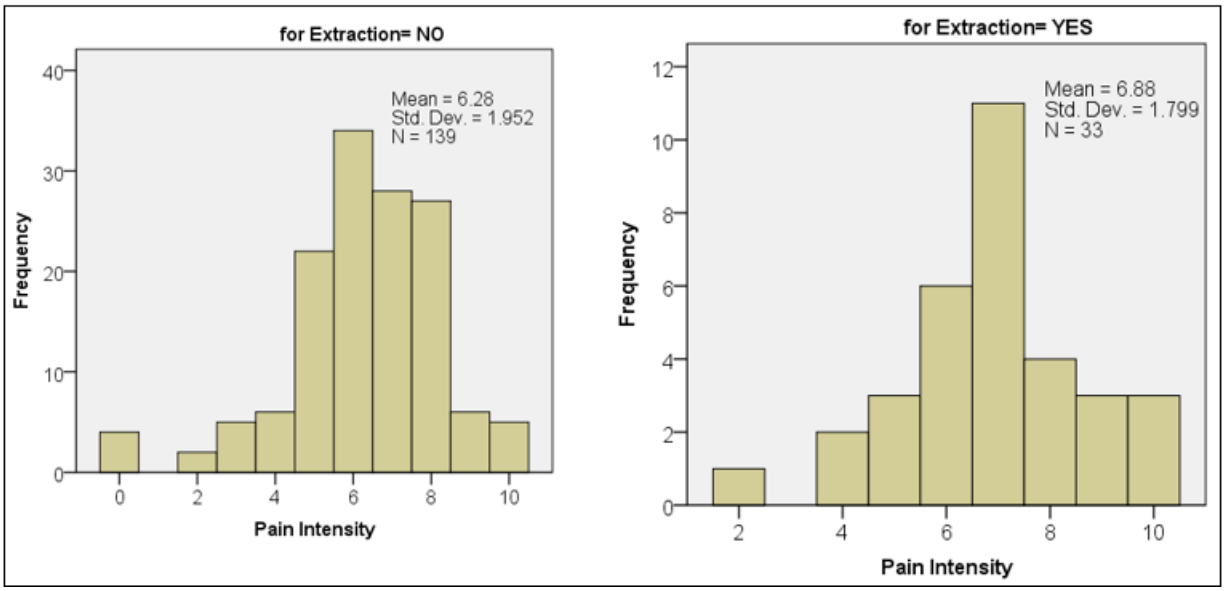


Figure 3: Frequency of tooth crowding patterns and tooth extractions for all patients.

Interesting, Figure 4 shows that patients who had a tooth extracted had a slightly higher pain intensity (mean ± standard deviation = 6.88 ± 1.80) compared with those who did not have a tooth extracted (mean ± standard deviation = 6.28 ± 1.95). However, an independent - samples t - test revealed that the difference was not significant (Table I).



(a) **(b)**

Figure 4: Frequency of each pain level for patients (a) who did not have a tooth extracted and (b) who did have a tooth extracted

Table I: The results of an independent - samples t - test for the pain intensity of patients who did and did not have a tooth extracted.

		Levene's test for equality of variances		t - test for equality of means						
		F	*p*	t	Degrees of freedom	*p* (two - tailed)	Mean Difference	Standard error difference	95% confidence interval of the difference	
									Lower	Upper
Pain Int	Equal variances assumed	0.390	0.533	- 1.605	170	0.110	- 0.598	0.373	- 1.334	0.137
	Equal variances not assumed			- 1.689	51.476	0.097	- 0.598	0.354	- 1.309	0.113

We divided the data set into five groups according to the tooth crowding pattern – spacing, normal, mild, moderate, and severe – to assess whether there was a difference in pain among the groups. As shown in Tables II and III, the mean value of perceived pain did not differ significantly between the groups (one - way ANOVA: F = 2.06, $p = 0.088$).

Table II: Descriptive statistics of pain intensity for each tooth crowding pattern (0 refers to no pain and 10 refers to the worst pain).

	N	Mean	Standard deviation	Standard error	95% confidence interval for the mean		Min	Max
					Lower bound	Upper bound		
Spacing	9	6.11	2.804	0.935	3.96	8.27	0	8
Normal	13	7.31	1.750	0.485	6.25	8.37	4	10
Mild	70	5.99	1.982	0.237	5.51	6.46	0	10
Moderate	53	6.51	1.887	0.259	5.99	7.03	0	10
Severe	26	6.88	1.451	0.285	6.30	7.47	5	10
Total	171	6.39	1.938	0.148	6.10	6.68	0	10

Table III: The results of one - way analysis of variance (ANOVA) for the five pain intensity for the tooth crowding patterns.

	Sum of squares	Degrees of freedom	Mean square	F	*p*
Between groups	30.206	4	7.551	2.060	0.088
Within groups	608.543	166	3.666		
Total	638.749	170			

Figure 5 shows a breakdown of some pain triggers in the sample. The most common triggers were chewing and biting (64.3% of all triggers), followed by pain at rest. The other triggers were much less common.

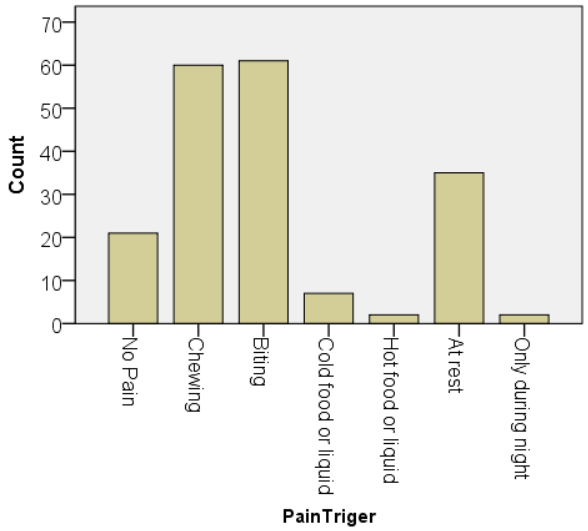


Figure 5: Frequency of pain triggers.

The average pain intensity between the male and female patients was not significantly different, although it was slightly higher in women (Figure 6). Of note, there were three outliers in the female group and one outlier in the male group.

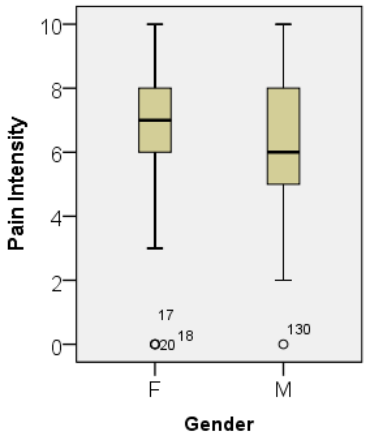


Figure 6: Boxplot of pain intensity in the male and female patients.

While tooth crowding can be noticed by both men and women, some factors may underlie why females seem to perceive it more often than males. For example, the location of teeth and the general shape of the jaw can be affected by hormonal changes during puberty and pregnancy, which may result in crowding. Moreover, women often have smaller jaws than men, which may also be a factor in the increased frequency of crowding. Although it is crucial to remember that tooth crowding is not just a gender - specific issue, in this study, crowding was reported more frequently by the female patients (Figure 7). However, the Pearson chi - square test showed that the difference between the male and female patients was not significant ($p = 0.139$; Table IV).

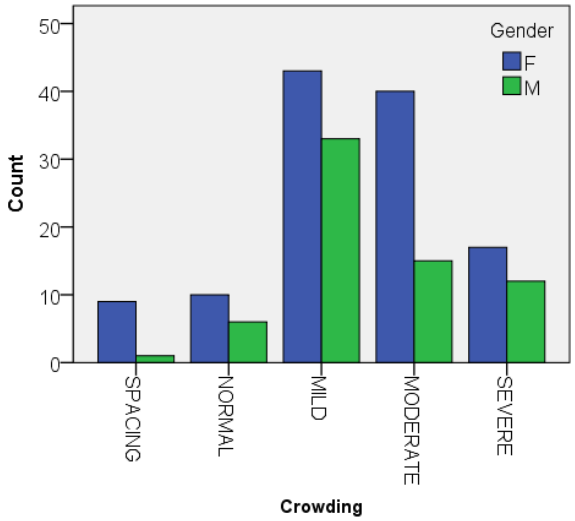


Figure 7: Frequency of the tooth crowding patterns for the male and female patients.

Table IV: The results of Pearson's chi - square test to assess differences in the tooth crowding patterns between males and females.

	Value	Degrees of freedom	*p* (two - sided)
Pearson's chi - square	6.947	4	0.139
Likelihood ratio	7.616	4	0.107
Number of valid cases	186		

We conducted an independent - samples t - test to assess whether medication provided relief for tooth pain. Table V shows a difference in the pain level: those who used medication perceived less pain. This finding suggests a potential correlation between the use of medication and reduced tooth pain in patients. It underlines the importance of medication in managing and alleviating dental discomfort. In contrast, the pain duration was not different between those who used pain medication and those who did not (Table VI).

Table V: The results of an independent - samples t - test for pain intensity comparing patients who did and did not take pain medication.

		Levene's test for equality of variances		t - test for equality of means						
		F	*p*	t	Degrees of freedom	*p* (two - tailed)	Mean Difference	Standard error difference	95% confidence interval of the difference	
									Lower	Upper
Pain Int	Equal variances assumed	4.594	0.034	- 2.450	170	0.015	- 0.725	0.296	- 1.309	- 0.141
	Equal variances not assumed			- 2.305	115.938	0.023	- 0.725	0.314	- 1.347	- 0.102

Table VI: The results of an independent - samples t - test for pain duration comparing patients who did and did not take pain medication.

		Levene's test for equality of variances		t - test for equality of means						
		F	*p*	t	Degrees of freedom	*p* (two - tailed)	Mean difference	Standard error difference	95% confidence interval of the difference	
									Lower	Upper
Duration	Equal variances assumed	0.053	0.818	- 0.878	169	0.381	- 0.205	0.233	- 0.666	0.256
	Equal variances not assumed			- 0.866	138.969	0.388	- 0.205	0.237	- 0.673	0.263

We found that in general, tooth pain started within 1 - 3 days after treatment and lasted up to 5 days (Figure 8). There were a few outliers for the start of the pain, which were related to the patients whose perceived pain started more than 3 days after treatment. More than 50% of the patients experienced pain for more than 3 days.

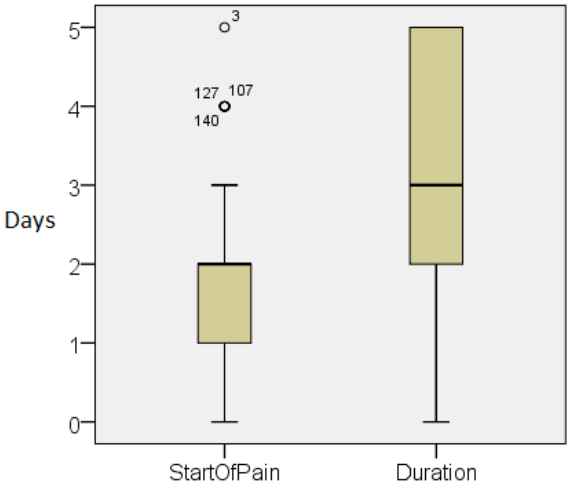


Figure 8: Boxplot for the start and duration of pain

Regarding the position of pain, as teeth shift into their appropriate alignment, patients may feel discomfort in the regions where there is pressure or stress. While tooth discomfort is normal throughout orthodontic treatment, it usually subsides as the teeth adjust to their new locations. Figure 9 shows that most of the pain was perceived in the anterior teeth, followed by the posterior teeth. This finding is consistent with the fact that orthodontic treatments are mainly conducted on the anterior and/or posterior teeth. Again, in all positions, pain seemed to be more frequent in the female patients.

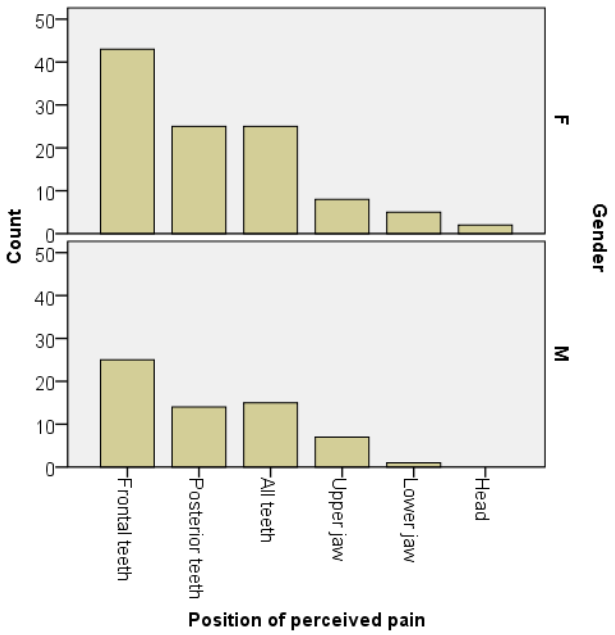


Figure 9: Frequency of pain based on the position

The most prominent type of pain perceived by far was pressure (Figure 10), a finding consistent with the fact that braces or aligners exert a steady force on teeth. This force creates discomfort by stimulating the nerves in the periodontal ligaments that surround the teeth. In contrast to acute or severe pain, discomfort due to pressure frequently persists following therapy. Pressure is a common sensation felt by patients during adjustments as their teeth move into new locations. Furthermore, the tightness of orthodontic equipment may increase the feeling of pressure.

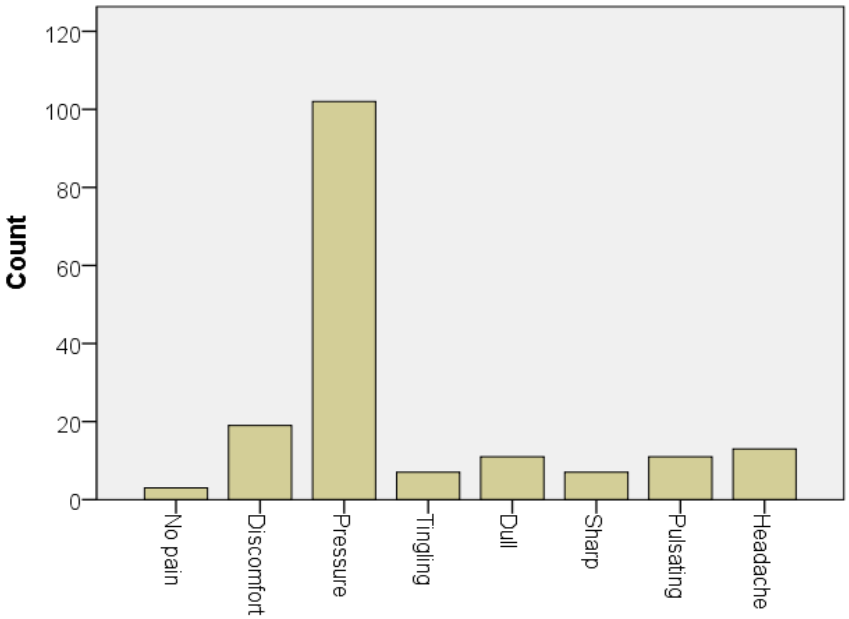


Figure 10: Frequency of the types of pain.

5. Discussion

Our primary goal was to conduct a comprehensive examination of the multitude of factors and dimensions that could affect pain following orthodontic treatment. Specifically, we delved into the intricate details surrounding pain levels and locations experienced by patients undergoing orthodontic therapy. By examining these aspects, we sought to gain a deeper understanding of the overall impact of orthodontic interventions on patients' well - being and comfort. We have shed light on the complex interplay between different factors such as orthodontic procedures and the sensations of pain, providing valuable insights for improving treatment protocols and enhancing patient experiences.

In out sample of 188 individuals aged 11 - 29 years, representative of the Jordanian population, we found that mild crowding was most noticed, with almost equal numbers in the male and female patients. Crowding impacts the requirement for extraction: the more severe the crowding, the more likely extraction will be required. An intriguing finding is a trend for a difference in pain intensity between the patients who did and did not have a tooth extracted. The pain level was marginally higher in the patients who had a tooth extracted. We also divided the data set into five groups based on five tooth crowding patterns – spacing, normal, mild, moderate, and severe. There was no significant difference in pain intensity among these patterns.

We found that the most common triggers that led people to perceive pain were chewing or biting. Pain perception can vary greatly among people due to a variety of factors, including pain tolerance, the severity of the orthodontic issue being treated, and variations in anatomy and physiology. Based on our statistical analysis, there was no significant difference in the pain intensity experienced by the male and female patients.

Although tooth crowding can affect men and women, certain factors may lead to women being more affected by tooth crowding than men. For example, hormonal changes during puberty and pregnancy can affect the general shape of the jaw and the placement of teeth, which can lead to crowding. In addition, a woman's jaw tends to be smaller than that of a man, which could also contribute to the higher frequency of crowding. It is important to keep in mind that tooth crowding is not just a problem that affects one gender over another. In this study, there was a trend for more frequent tooth crowding in the female patients, but the difference was not significant.

We found a significant difference in the pain intensity between patients who did and did not use pain medication. Specifically, those who used pain medication reported a significantly lower level of perceived pain. Conversely, the use of pain medication did not significantly affect the duration of pain. This suggests that while the level of pain decreases with medication, the duration of pain does not. Overall, we observed that dental pain could appear any time from 1 to 3 days after treatment and could continue for up to 5 days. Regarding the location of pain, patients typically experience discomfort in the areas that are under pressure or tension when their teeth move into their proper alignment. While soreness in the teeth is common throughout orthodontic treatment, it is important to keep in mind that this discomfort normally diminishes as the teeth adjust to their new positions.

Finally, the prevailing form of pain perceived was pressure, which is primarily due to the consistent force exerted by braces or aligners on the teeth. The sensation of pressure arises from stimulation of nerves within the periodontal ligament encircling the teeth. Patients frequently experience pressure sensations when braces are adjusted as their teeth shift positions, and the tightness of orthodontic appliances may further amplify this sensation.

6. Conclusion

We assessed 188 individuals from the Jordanian population to evaluate the nature and location of pain experienced when undergoing orthodontic treatment, considering factors such as gender, pain intensity, pain location and duration, extraction,

pain triggers, and the influence of medical interventions on pain duration and intensity. We found that tooth crowding and extraction did not significantly affect the pain experienced during orthodontic procedures. Specifically, chewing and biting were the primary contributors to perceived discomfort. Additionally, most participants reported experiencing pain within the initial days following treatment, lasting up to 5 days in some cases. Furthermore, the female patients seem to experience more pronounced levels of pain and crowding. This finding suggests a potential correlation between medication use and reduced tooth pain among patients. However, while pain medication may reduce pain intensity, it may not necessarily reduce the duration of pain. Studying the nature of pain in orthodontic treatment is crucial for tailored patient care. Understanding gender differences, pain intensity, and triggers aids in developing personalised pain management strategies. Analysing pain duration and location helps improve treatment outcomes and patient comfort. Assessing the impact of medical interventions guides the refinement of orthodontic procedures for enhanced pain relief.

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