

## Original Research

### Comparison of pain perception caused by aligner and conventional fixed orthodontic treatments

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#### ABSTRACT:

**Background:** There has been a notable increase in the number of adults seeking orthodontic treatment, accompanied by a growing demand for esthetically acceptable and comfortable alternatives to conventional fixed appliances. Hence; the present study was conducted for comparing pain perception caused by aligner and conventional fixed orthodontic treatments.

**Materials & methods:** A total of 50 orthodontic patients presenting with mild maxillary dental crowding measuring between 3 and 6 mm and planned for non-extraction therapy were recruited for this investigation. The participants were randomly allocated into two equal groups, comprising twenty individuals in the fixed orthodontic appliance group and twenty in the clear aligner group, with each group consisting of ten males and ten females to maintain gender balance. For both groups, the therapeutic focus remained exclusively on the maxillary arch, ensuring uniformity in treatment objectives and allowing for direct comparison of patient experiences. To evaluate discomfort associated with each modality, pain perception was systematically recorded using a visual analog scale (VAS) at predetermined intervals. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software. **Results:** The mean age of participants in the fixed appliance group was slightly higher (23.5 years) compared to the aligner group (21.8 years). Across all early time points—2nd hour, 6th hour, 1st day, 2nd day, and 3rd day—the fixed treatment group consistently reported significantly higher pain scores than the aligner group, with p-values indicating strong statistical significance ( $p < 0.05$ ). By the 7th day, pain levels had substantially decreased in both groups, and the difference between them was no longer statistically significant ( $p = 0.532$ ). **Conclusion:** Clear aligner therapy resulted in significantly lower pain levels during the initial days of orthodontic treatment compared to fixed appliances, with discomfort diminishing in both groups by the end of the first week. These findings indicate that aligners offer a more comfortable early treatment experience while achieving comparable therapeutic objectives.

**Key words:** Pain perception, Aligner, Orthodontic treatments

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#### INTRODUCTION

In recent years, there has been a notable increase in the number of adults seeking orthodontic treatment, accompanied by a growing demand for esthetically acceptable and comfortable alternatives to conventional fixed appliances.<sup>1, 2</sup> The origins of modern clear aligner therapy can be traced back to 1946, when Kesling first proposed the concept of using a sequence of thermoplastic tooth positioners to incrementally move teeth into improved alignment. This innovative idea laid the foundation for the

development of transparent orthodontic systems, which were described in the same year. A major advancement occurred in 1997 when Align Technology, a company based in Santa Clara, California, transformed Kesling's concept into a clinically viable modality by integrating advanced digital and manufacturing technologies.<sup>4</sup> This marked the beginning of clear aligner therapy (CAT) as it is widely recognized today. Despite its growing popularity and its promotion as a comfortable, safe, and cosmetically superior form of orthodontic

treatment for adults, the scientific literature remains relatively limited with regard to predicting treatment outcomes and understanding its full capabilities.<sup>4</sup> <sup>5</sup>Manufacturers of systems such as Invisalign claim that clear aligners can achieve complex orthodontic movements, including bicuspid derotation of up to 50 degrees and root translation of maxillary central incisors by as much as 4 mm.<sup>6</sup> Fixed orthodontic appliances such as braces demand rigorous oral hygiene to prevent complications. Because patients attend regular monthly checkups, they are given strict cleaning and dietary instructions, including avoiding sticky or hard-to-chew foods that can trap residue. Poor plaque control can quickly lead to periodontal inflammation and enamel demineralization, with marginal gingivitis, deep periodontal damage, and white spot lesions being the most frequent problems when hygiene is neglected during treatment.<sup>7,8</sup> Hence; the present study was conducted for comparing pain perception caused by aligner and conventional fixed orthodontic treatments.

## MATERIALS & METHODS

A total of 50 orthodontic patients presenting with mild maxillary dental crowding measuring between 3 and 6 mm and planned for non-extraction therapy were recruited for this investigation. The participants were randomly allocated into two equal groups, comprising twenty individuals in the fixed orthodontic appliance group and twenty in the clear aligner group, with each group consisting of ten males and ten females to maintain gender balance. In the fixed appliance group, orthodontic treatment commenced using a 0.014-inch round nickel–titanium archwire, placed within a 0.018 × 0.025-inch preadjusted edgewise bracket system, allowing for controlled initial alignment and leveling.

Conversely, individuals assigned to the aligner group began treatment with a polyurethane-based clear aligner system, designed to provide staged tooth movement through sequential removable trays. For both groups, the therapeutic focus remained exclusively on the maxillary arch, ensuring uniformity in treatment objectives and allowing for direct comparison of patient experiences. To evaluate discomfort associated with each modality, pain perception was systematically recorded using a visual analog scale (VAS) at predetermined intervals. This approach enabled a detailed assessment of the onset, peak intensity, and progression of pain throughout the first week of orthodontic intervention. All the results were recorded in Microsoft excel sheet and were subjected to statistical analysis using SPSS software.

## RESULTS

The mean age of participants in the fixed appliance group was slightly higher (23.5 years) compared to the aligner group (21.8 years). The fixed treatment group consisted of 15 males and 10 females, whereas the aligner group included 17 males and 8 females, indicating a relatively comparable gender distribution between the two groups. Across all early time points—2nd hour, 6th hour, 1st day, 2nd day, and 3rd day—the fixed treatment group consistently reported significantly higher pain scores than the aligner group, with p-values indicating strong statistical significance ( $p < 0.05$ ). By the 7th day, pain levels had substantially decreased in both groups, and the difference between them was no longer statistically significant ( $p = 0.532$ ). These findings demonstrate that clear aligner therapy is associated with considerably lower early treatment discomfort compared to fixed orthodontic appliances.

**Table 1: Demographic data**

Variable	Fixed Treatment Group	Aligner Group
Mean age (years)	23.5	21.8
Males	15	17
Females	10	8

**Table 2: Comparison of the Fixed Treatment and Aligner Groups in Terms of VAS Scores**

Time Interval	Fixed Treatment Group	Aligner Group	p-value
2 <sup>nd</sup> hour	1.95	0.36	0.000*
6 <sup>th</sup> hour	3.42	1.17	0.005*
1 <sup>st</sup> day	5.69	2.76	0.000*
2 <sup>nd</sup> day	4.17	1.53	0.001*
3 <sup>rd</sup> day	3.88	1.21	0.003*
7 <sup>th</sup> day	1.56	0.53	0.532

## DISCUSSION

Pain, as defined by the International Association for the Study of Pain, is an unpleasant sensory and emotional experience linked to actual or potential tissue injury. In dentistry—particularly orthodontics—pain is common and often persists for several days after appliance activation, with most patients reporting peak discomfort within the first few days. Pain

remains a major reason for treatment avoidance and poor compliance.<sup>9</sup> Orthodontic appliances, whether fixed or removable, introduce foreign forces into a highly sensitive anatomical region. Although the exact mechanisms behind orthodontic pain are not fully clarified, it results from a sequence of inflammatory, vascular, neural, and cellular responses triggered by orthodontic force application. Importantly, the

magnitude of applied force does not directly predict the degree of pain experienced, as pain perception is influenced by multiple psychological and cultural factors, including fear, prior experience, and individual sensitivity.<sup>10, 11</sup>Hence; the present study was conducted for comparing pain perception caused by aligner and conventional fixed orthodontic treatments.

In the present study, the mean age of participants in the fixed appliance group was slightly higher (23.5 years) compared to the aligner group (21.8 years). Across all early time points—2nd hour, 6th hour, 1st day, 2nd day, and 3rd day—the fixed treatment group consistently reported significantly higher pain scores than the aligner group, with p-values indicating strong statistical significance ( $p < 0.05$ ). By the 7th day, pain levels had substantially decreased in both groups, and the difference between them was no longer statistically significant ( $p = 0.532$ ). Jnananjan Chattopadhyay conducted a comparative evaluation of pain perception among patients receiving conventional fixed orthodontic therapy versus those treated with clear aligners. Using patient-reported outcome measures and applying statistical analyses with a significance threshold of  $p < 0.05$ , the study demonstrated a clear difference in early treatment discomfort between the two modalities. Patients undergoing aligner therapy consistently reported markedly lower pain levels, especially during the initial adjustment period, compared with individuals treated with traditional fixed appliances. These findings highlight that clear aligners offer a more patient-friendly and comfortable alternative, making them particularly advantageous for individuals who prioritize reduced pain and improved treatment experience during orthodontic care.<sup>11</sup>Alturki G et al compared the perception of pain intensity between patients treated with fixed orthodontic appliances and those treated with clear removable aligners. Two hundred participants, 100 treated with fixed orthodontic appliances (G1) and 100 with clear removable aligners (G2), filled the Short-form McGill Pain Questionnaire (SF-MPQ), the Numeric Pain Rating scale (NPRS), and the Present Pain Index (PPI) at baseline (before orthodontic adjustment or changing to a new aligner) and 24-hours post-adjustment visit. The mean change in the NPRS values from baseline to 24-hour post-adjustment showed significantly higher pain intensity in G1 ( $3.15 \pm 2.47$ ) compared to G2 ( $1.58 \pm 1.74$ ) ( $p < 0.0001$ ). There was also a statistically significant difference in the frequency of reporting of SF-MPQ pain descriptors between G1 and G2, with more pain associated with G1. The PPI 24-hours post-adjustment showed that 94% of G1 reported some form of pain compared to only 79% in G2. At the 24-hour post-adjustment visit, 34 participants in G1 and only 8 participants in G2 reported the use of analgesic medications ( $p < 0.0001$ ). Overall, patients treated with fixed orthodontic appliances reported higher pain

perception compared to patients treated with clear removable aligners during the first 24 hours following the adjustment visit.<sup>12</sup>

## CONCLUSION

Clear aligner therapy resulted in significantly lower pain levels during the initial days of orthodontic treatment compared to fixed appliances, with discomfort diminishing in both groups by the end of the first week. These findings indicate that aligners offer a more comfortable early treatment experience while achieving comparable therapeutic objectives.

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