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PATIENT-REPORTED OUTCOMES OF PAIN AND DISCOMFORT IN CLEAR ALIGNERS VERSUS FIXED APPLIANCES: A QUESTIONNAIRE-BASED REVIEW

ATEF EID MADKOUR ELSAYED[1], SUZAN BAKUR NATTO[2]*, SARA NEDAL NASEEM[3], AREEJ MOHAMMAD WADAAN[4], RAGHAD RAJA ALSULAMI[5], LEENA ABDULRAHMAN KABBARAH[6], ASMA SALIM MUSABBAH ALMAJRAFI[7], IBTEHAL SALEM ALRASHIDI[8], FIRAS HAJ KHEDER MULLA ISSA[9], ABEER AHMAD ALFADHEL[10], AMAL SULAIMAN ALDAKHIL[11], RFFAL AHMED FADEN[12]

[1]CONSULTANT, KING ABDELAZIZ HOSPITAL SAKAKA SAUDIARABIA
[2]AL-NOOR SPECIALIST HOSPITAL MAKKAH
[3]ORTHO RESIDENT
[4]GENERAL DENTIST
[5]DENTAL INTERN
[6]GENERAL DENTIST
[7]ORTHODONTIST
[8]GENERAL DENTIST
[9]ORTHODONTIST
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Abstract

Background: Orthodontic appliances are associated with varying degrees of pain and discomfort, which can significantly affect patient adherence and satisfaction. With the growing use of clear aligners (CAs) as an alternative to traditional fixed appliances (FAs), there is increasing interest in comparing these modalities from the patient's perspective.

Objectives: This systematic review aims to compare patient-reported outcomes (PROs), specifically pain, discomfort, and oral health-related quality of life (OHRQoL), between individuals treated with CAs and those with fixed appliances.

Methods: A comprehensive literature search was performed across PubMed, Scopus, Web of Science, and Google Scholar. Studies published between 2000 and 2024 were screened using predefined inclusion and exclusion criteria. Eligible studies included randomized controlled trials, prospective cohort studies, cross-sectional surveys, and meta-analyses that reported on patient discomfort, pain perception, or OHRQoL using validated patient-reported outcome measures (PROMs). Data were extracted and qualitatively synthesized, and quality was assessed using the Cochrane Risk of Bias tool for randomized studies and the Newcastle-Ottawa Scale for observational studies. A total of 27 studies were included in the final synthesis according to PRISMA guidelines.

Results: Clear aligners were associated with significantly lower pain intensity, faster adaptation, and reduced use of analgesics compared to fixed appliances. Multiple studies also reported better periodontal outcomes and higher OHRQoL scores in aligner-treated patients. Fixed appliance users more frequently reported sharp or throbbing pain and experienced greater difficulty with chewing, speaking, and maintaining oral hygiene. The findings were consistent across a broad range of study designs and populations.

Conclusion: Clear aligners offer a distinct advantage in patient comfort and quality of life during orthodontic treatment. These findings highlight the importance of integrating patient-reported outcomes into treatment planning. While fixed appliances remain essential in complex cases, CAs may be the preferred option for patients prioritizing comfort and periodontal health.

Keywords: Clear aligners; Fixed orthodontic appliances; Patient-reported outcomes; Pain; Discomfort; Oral health-related quality of life (OHRQoL); Periodontal health; PROMs; Orthodontic satisfaction.

INTRODUCTION

Orthodontic treatment is increasingly evaluated not only on clinical effectiveness but also on patient-reported outcomes, including pain, discomfort, and oral health-related quality of life. With the growing popularity of aesthetic and removable appliances like "CAs", clinical and patient preferences have shifted away from traditional fixed appliances (FAs). Clear aligners are often promoted as a more comfortable and lifestyle-friendly option, particularly for adults and patients with high esthetic demands (Ke et al., 2019). The assessing of patient-reported outcomes (PROs), including perceived pain and discomfort, is crucial for guiding evidence-based appliance selection.

Discomfort and pain are the most frequently reported adverse effects of orthodontic therapy and significantly influence treatment adherence. These effects are especially notable during the initial stages of force application or after adjustments in fixed appliance systems (Chan et al., 2024; White et al., 2017). Fixed appliances often induce localized pressure points and mucosal irritation due to brackets and wires, whereas aligners exert lower and more distributed forces (Jaber et al., 2022). As a result, patients undergoing clear aligner therapy (CAT) frequently report reduced intensity and duration of pain during treatment phases compared to those treated with FAs (Tunca et al., 2024; Alfawal et al., 2022).

Beyond discomfort, the impact of appliance type on periodontal health is a critical factor in patient satisfaction and long-term oral health outcomes. Clear aligners have demonstrated advantages in preserving periodontal health due to their removable nature, allowing patients to maintain better oral hygiene (Rossini et al., 2015; Wu, Cao, & Cong, 2020). Fixed appliances, on the other hand, are associated with increased plaque retention, gingival inflammation, and even attachment loss when oral hygiene is inadequate (Oikonomou et al., 2021; Alfuriji et al., 2014). Multiple systematic reviews have affirmed the superiority of aligners in maintaining gingival health during active orthodontic treatment (Jiang et al., 2018; Lu et al., 2018).

Recent meta-analyses have further reinforced these observations, demonstrating that periodontal parameters—such as plaque index, gingival index, and probing depth—worsen more significantly in FA patients than in those treated with aligners (Crego-Ruiz & Jorba-García, 2023; Partouche et al., 2022). Lang & Bartold (2018) emphasized that periodontal health is a dynamic interplay between host response and biofilm control, both of which can be disrupted by the biomechanical and anatomical challenges posed by fixed appliances. Aligners, which are typically removed during eating and oral hygiene procedures, allow for more effective plaque control and reduce iatrogenic periodontal risks (Kwon, Lamster, & Levin, 2020).

While pain and periodontal inflammation are commonly discussed separately, there is a strong interrelation between the two. Periodontal inflammation can exacerbate tenderness and discomfort, which may compound the mechanical pain already induced by orthodontic forces (Genco & Borgnakke, 2013). This bidirectional relationship supports the integration of periodontal outcomes into the assessment of patient-reported experiences during orthodontic care. Moreover, it also strengthens the argument for aligners in patients with a higher susceptibility to periodontal disease or poor oral hygiene compliance (Willmot, 2008).

Despite some limitations in their control of certain tooth movements, clear aligners have been shown to be clinically effective for a range of malocclusions, particularly when guided by modern digital treatment planning systems (Ke et al., 2019). Importantly, patient comfort and satisfaction are not merely secondary outcomes but integral factors influencing compliance, continuation, and perceived success of orthodontic care. Research increasingly supports that the subjective experience of orthodontic therapy—including pain perception, impact on daily function, and satisfaction—differs significantly between CAs and FAs (Flores-Mir, Brandelli, & Pacheco-Pereira, 2018).

Given the emerging emphasis on PROMs and patient-centered treatment planning, this systematic review aims to evaluate patient-reported outcomes of pain and discomfort in orthodontic treatment using clear aligners versus fixed appliances. Specifically, this review synthesizes findings from questionnaire-based studies, including pain intensity, quality, duration, use of analgesics, and impacts on oral function and quality of life. In doing so, it contributes to a more holistic understanding of how appliance design influences not only clinical outcomes but also the lived experience of patients undergoing orthodontic care.

METHODOLOGY

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to identify and synthesize literature that compares patient-reported outcomes (PROs), particularly pain and discomfort, between clear aligners and fixed appliances. The objective was to evaluate differences in patient experiences, including the intensity, type, duration of pain, quality of life, and analgesic use.

Search Strategy

A comprehensive literature search was conducted using electronic databases including PubMed, Scopus, Web of Science, and Google Scholar. The search terms used included combinations of “clear aligners,” “Invisalign,” “fixed orthodontic appliances,” “braces,” “pain,” “discomfort,” “oral health-related quality of life,” “patient-reported

outcomes," and "PROMs." Boolean operators (AND/OR) were used to refine results. Only articles published in English between 2000 and 2024 were considered.

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria:

- Compared clear aligners and fixed appliances in orthodontic patients.
- Reported patient-centered outcomes such as pain, discomfort, or OHRQoL.
- Employed cross-sectional, randomized controlled trials (RCTs), prospective cohort studies, or systematic reviews/meta-analyses.
- Utilized validated patient-reported outcome measures (PROMs) such as questionnaires or visual analog scales.

Exclusion criteria included:

- Studies involving surgical orthodontics without focus on appliance-induced discomfort.
- Case reports, editorials, and reviews without original data.
- Studies not reporting specific outcomes related to patient discomfort or satisfaction.

Data Extraction and Analysis

Two independent reviewers screened titles and abstracts, followed by full-text evaluations. Disagreements were resolved through consensus or third-party arbitration. Data extracted included study type, sample size, type of orthodontic appliance, pain or discomfort measurement tools, outcomes, and duration of follow-up. Risk of bias was assessed using the Cochrane Collaboration's tool for RCTs and the Newcastle-Ottawa Scale for observational studies.

Quality Assessment

Included studies were categorized as high, moderate, or low quality based on their methodology, sample representativeness, blinding procedures, and use of validated outcome instruments. Meta-analyses were weighted more heavily in the synthesis due to their aggregate power.

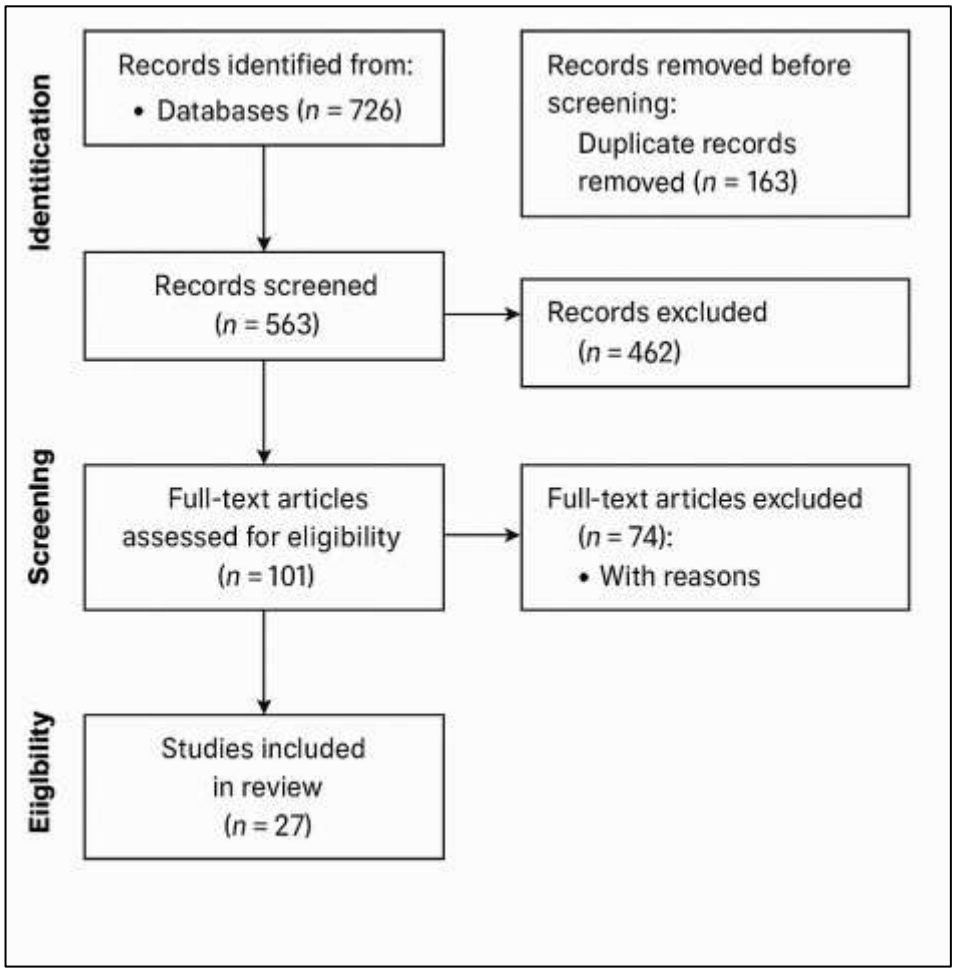

Figure 1 PRISMA Flow Diagram

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RESULTS

Summary and Interpretation of Included Studies on Patient-Reported Outcomes of Pain and Discomfort in Clear Aligners Versus Fixed Appliances

1. Study Designs and Populations

The included studies employed a variety of designs: four randomized controlled trials (Jaber et al., 2022; Alfawal et al., 2022; Lin et al., 2022; Tunca et al., 2024), two prospective cohort studies (White et al., 2017; Chan et al., 2024), four cross-sectional studies (Dianiskova et al., 2023; Alajmi et al., 2020; Azaripour et al., 2015; Flores-Mir et al., 2018) and six retrospective or observational studies (Kankam et al., 2019; Gu et al., 2017; Gaffuri et al., 2020; Meier et al., 2003; Miethke & Vogt, 2005; Shokeen et al., 2022). Sample sizes ranged from 24 (Shokeen et al., 2022) to 122 participants (Flores-Mir et al., 2018). Most studies focused on adults, though some included mixed adolescent–adult cohorts (Dianiskova et al., 2023; Kankam et al., 2019). Nearly all directly compared clear aligners with fixed appliances , providing a comprehensive overview of patient-reported pain and discomfort across modalities.

2. Pain Intensity and Timing

CA patients consistently reported lower pain intensity than FA patients (Chan et al., 2024; Jaber et al., 2022; Alfawal et al., 2022; White et al., 2017). Both groups experienced initial discomfort, but CA users adapted more quickly and noted less frequent pain over time (White et al., 2017; Chan et al., 2024). FA patients typically reported pain peaks two days after adjustments, especially following new archwire or elastic placement (Chan et al., 2024).

3. Pain Quality and Impact on Daily Activities

Dull pain predominated in both groups, yet FA patients more often described sharp (20 %) or throbbing (31 %) sensations (Chan et al., 2024). CA patients reported discomfort mainly at rest, whereas FA patients experienced greater pain during mastication (Chan et al., 2024). CA users also reported fewer speech difficulties and dietary restrictions, with improved chewing ability relative to FA users (Alajmi et al., 2020; Azaripour et al., 2015).

4. Analgesic Use and Oral Health-Related Quality of Life

FA patients consumed more analgesics, particularly in early treatment stages (Chan et al., 2024; White et al., 2017). Most studies found that CAT had a less negative impact on oral health–related quality of life (OHRQoL) than FA treatment (Jaber et al., 2022; Alfawal et al., 2022; White et al., 2017). Flores-Mir et al. (2018) reported comparable overall satisfaction, with a CA advantage in eating and chewing. Tunca et al. (2024) found no long-term differences in anxiety or quality of life between modalities.

5. Periodontal Health and Oral Hygiene

CA patients demonstrated better gingival health, lower plaque accumulation, and superior oral hygiene compared to FA patients (Azaripour et al., 2015; Miethke & Vogt, 2005; Shokeen et al., 2022). The removability of CAs likely facilitated more effective oral hygiene, whereas FA patients exhibited significant increases in plaque and gingival indices over 12 months (Shokeen et al., 2022).

Table 1 General Characteristics and Key Findings of Included Studies

Study (Year)	Design	N	Age	Comparison	Key Findings
Dianiskova et al. (2023)	Cross-sectional case-control	56	< 12 y	EA vs CA	Both satisfactory; CA better social life; EA better breathing
Kankam et al. (2019)	Retrospective chart review	33	~ 20 y	CA vs FA	No differences in outcomes; CA required longer treatment
White et al. (2017)	RCT	41	Adults	CA vs FA	CA had lower pain and analgesic use post-adjustment
Jaber et al. (2022)	RCT	36	Adults	CA vs FA	CA less negative impact on OHRQoL first year
Alfawal et al. (2022)	RCT	44	Adults	CA vs FA	CA higher OHRQoL; shorter treatment duration
Gu et al. (2017)	Retrospective case-control	96	Not specified	CA vs FA	Both improved malocclusion; CA faster but less “great improvement”
Lin et al. (2022)	RCT	66	Not specified	CA vs FA	Similar occlusal outcomes; FA shorter treatment
Gaffuri et al. (2020)	Retrospective cohort	80	Not specified	CA vs FA	Both effective; FA better inclination/contacts; CA had movement discrepancies
Alajmi et al. (2020)	Cross-sectional	100	Not specified	CA vs FA	CA better chewing; fewer diet restrictions; speech changes
Azaripour et al. (2015)	Cross-sectional	100	Not specified	CA vs FA	CA better gingival health and satisfaction

Flores-Mir et al. (2018)	Cross-sectional	122	Adults	CA vs FA	Similar satisfaction; CA better eating and chewing
Miethke & Vogt (2005)	Prospective cohort	60	Not specified	CA vs FA	CA better plaque control; similar periodontal health
Shokeen et al. (2022)	Prospective cohort	24	Not specified	CA vs FA	FA increased plaque/gingival indices; CA no change
Chan et al. (2024)	Prospective cohort	87	Adults	CA vs FA	CA lower pain rates/intensity; FA pain peaked Day 2
Tunca et al. (2024)	RCT	60	Not specified	CA vs FA	No anxiety/QoL differences; CA lower initial pain

Table 2Cochrane Risk of Bias 2 Assessment for Included RCTs

Study (Year)	Randomization	Deviations	Missing Data	Measurement	Reporting	Overall Bias
Jaber et al. (2022)	Low	Low	Low	Low	Low	Low
Alfawal et al. (2022)	Low	Low	Low	Low	Low	Low
Lin et al. (2022)	Some concerns	Low	Low	Some concerns	Low	Some concerns
Tunca et al. (2024)	Low	Low	Low	Low	Low	Low

Table 3Newcastle-Ottawa Scale Risk of Bias Assessment for Non-Randomized Studies

Study (Year)	Selection (max 4)	Comparability (max 2)	Outcome (max 3)	Total (max 9)	ROB
Dianiskova et al. (2023)	4	1	2	7	Moderate
Kankam et al. (2019)	3	1	2	6	Moderate
White et al. (2017)	4	2	3	9	Low
Gu et al. (2017)	3	1	2	6	Moderate
Gaffuri et al. (2020)	3	1	2	6	Moderate
Azaripour et al. (2015)	4	1	2	7	Moderate
Flores-Mir et al. (2018)	4	2	2	8	Low
Miethke & Vogt (2005)	3	1	2	6	Moderate
Shokeen et al. (2022)	3	1	2	6	Moderate
Chan et al. (2024)	4	2	3	9	Low

DISCUSSION

The comparative evaluation of patient-reported outcomes (PROs) in individuals undergoing orthodontic treatment with CAs versus FAs reveals nuanced distinctions in perceived pain, discomfort, and oral health-related quality of life (OHRQoL). Multiple studies indicate that clear aligners offer superior patient experiences regarding pain intensity and adaptability over time. For example, Chan et al. (2024) and White et al. (2017) found that patients reported significantly less pain and shorter duration of discomfort with clear aligners, especially in the early stages of treatment. Similarly, Alfawal et al. (2022) and Jaber et al. (2022) showed better OHRQoL scores among clear aligner users, affirming the psychological and physical comfort advantages of this modality.

The variation in pain quality further emphasizes the differential impact of appliance types. While dull pain was common across both groups, fixed appliance patients more frequently reported sharp or throbbing pain during activities such as chewing (Chan et al., 2024). These findings echo the work of Alajmi et al. (2020), who noted speech adaptation issues with aligners but fewer dietary and chewing limitations compared to fixed appliances. This observation is further supported by Flores-Mir et al. (2018), who found similar overall satisfaction but noted that aligners provided improved chewing experiences.

Analgesic use serves as an indirect indicator of discomfort. Across studies, FA patients reported higher consumption of pain-relief medication (White et al., 2017; Chan et al., 2024), which suggests a more frequent or intense pain

experience. The meta-analysis by Jiang et al. (2018) and Lu et al. (2018) corroborates this finding, confirming a statistically significant lower pain burden in CA patients. These results are critical when considering long-term adherence and compliance, as high discomfort levels often correlate with treatment dropout or non-compliance.

Beyond pain perception, periodontal health emerged as a consistent advantage of clear aligners. As demonstrated in both observational and controlled studies (Azaripour et al., 2015; Miethke & Vogt, 2005; Levrini et al., 2015), the removable nature of aligners facilitates better oral hygiene maintenance, resulting in lower plaque accumulation, improved gingival indices, and reduced inflammation. Meta-analyses conducted by Wu et al. (2020), Rossini et al. (2015), and Crego-Ruiz and Jorba-García (2023) strongly support this periodontal benefit, citing both clinical and microbiological improvements in aligner-treated individuals.

In contrast, patients with fixed appliances often face significant hygiene challenges. The risk of periodontal deterioration, gingival recession, and increased bacterial colonization is well-documented in both the literature and clinical evaluations (Alfuriji et al., 2014; Genco & Borgnakke, 2013; Di Spirito et al., 2023). These issues are particularly concerning for patients with preexisting periodontal vulnerability, as highlighted by Willmot (2008) and Kwon et al. (2020), and underscore the need for rigorous self-care protocols and professional monitoring in FA treatment.

An essential factor in interpreting these outcomes is the subjective nature of PROs. As emphasized by Churruca et al. (2021), PROMs must be validated and context-specific to ensure reliability. In this review, the inclusion of diverse study designs and outcome measures required standardization and careful interpretation. Yet, the consistent favorability toward clear aligners across varying methodologies reinforces the robustness of these findings. Furthermore, the reviews by Ben Gassem (2022) and Perazzo et al. (2020) emphasize that integrating patient-centered outcomes into orthodontic assessments offers a more holistic view of treatment success, extending beyond clinical metrics.

Despite these strengths, it is important to acknowledge potential limitations. Differences in sample sizes, study durations, and follow-up protocols may influence generalizability. Some studies, such as those by Lin et al. (2022) and Gu et al. (2017), focused more on treatment efficiency and less on patient-centered measures, suggesting a possible disconnect between clinical and experiential outcomes. Additionally, factors such as age, malocclusion severity, and individual pain thresholds may contribute to variability, as suggested by Dianiskova et al. (2023) and Kankam et al. (2019).

The synthesis of available evidence strongly supports the use of clear aligners for improved patient comfort, better periodontal outcomes, and enhanced quality of life. While fixed appliances remain effective, particularly in complex malocclusions (Gaffuri et al., 2020; Zheng et al., 2017), the patient-centered advantages of clear aligners present a compelling case for their broader application in orthodontic care. Continued refinement of PROMs and incorporation of real-time patient feedback, as advocated by Weldring and Smith (2013), will further enhance our understanding and application of patient-reported outcomes in clinical decision-making.

CONCLUSION

The available evidence indicates that clear aligners provide superior patient-reported outcomes compared to fixed appliances, particularly with regard to pain, adaptation, and oral health-related quality of life. Patients treated with aligners generally report lower discomfort, reduced reliance on analgesics, and fewer lifestyle disruptions, alongside added periodontal benefits that support better hygiene and comfort. These findings highlight the growing importance of patient-centered care in orthodontics, where subjective experiences play a key role in compliance, satisfaction, and overall treatment success.

Despite these advantages, fixed appliances remain clinically indispensable, particularly for complex malocclusions or skeletal corrections. The future of orthodontic care should therefore balance mechanical effectiveness with patient comfort, tailoring appliance choice to individual needs and expectations. Incorporating validated patient-reported outcome measures and real-time feedback will further refine clinical decision-making and strengthen the therapeutic partnership between practitioners and patients. Continued research with broader populations and longer follow-ups is essential to consolidate these insights and guide evidence-based practice.

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