The Review Of
DIABETIC
STUDIES OPEN ACCESS

Clear Aligners Versus Fixed Appliances In Malocclusion Treatment: A Systematic Review Of Efficacy And Patient Satisfaction

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Abstract

Background: Orthodontic treatment traditionally relied on fixed appliances, but the rise of clear aligners has introduced an aesthetic and comfortable alternative. Understanding their relative efficacy and patient-reported outcomes is essential for evidence-based decision-making.
Objectives: This systematic review aimed to compare the clinical effectiveness, long-term stability, patient satisfaction, and periodontal outcomes of clear aligners versus fixed appliances in malocclusion treatment.
Methods: The review adhered to PRISMA 2020 guidelines. Databases including PubMed, Scopus, Web of Science, Embase, and Google Scholar were searched from 2010 to 2024. Eligible studies involved human subjects undergoing treatment with either clear aligners or fixed appliances, with outcomes including treatment efficacy, patient-reported satisfaction, periodontal health, and long-term stability. Data extraction and risk of bias assessment were performed independently by two reviewers.
Results: Fourteen studies met inclusion criteria. Clear aligners demonstrated comparable treatment effectiveness to fixed appliances in mild-to-moderate malocclusions, though fixed appliances retained superiority in complex movements such as torque and rotations. Aligners were consistently associated with greater comfort, reduced pain, higher patient satisfaction, and improved oral health-related quality of life. Periodontal outcomes favored aligners due to easier oral hygiene maintenance, while compliance and acceptance were higher among aligner patients. Long-term outcomes showed similar stability between both modalities, although high-quality randomized controlled trials remain limited.
Conclusions: Clear aligners represent a clinically effective and patient-preferred alternative to fixed appliances, particularly in cases of mild-to-moderate malocclusion. While aligners offer advantages in comfort, satisfaction, and periodontal health, fixed appliances maintain biomechanical advantages in complex cases. Careful case selection remains critical, and further large-scale, long-term trials are needed to strengthen the evidence base.

Keywords Clear aligners; fixed appliances; malocclusion; orthodontic treatment; patient satisfaction; periodontal health; treatment outcomes; compliance; Invisalign®; systematic review.

Clear aligner therapy has transformed orthodontics in the past two decades, offering an alternative to fixed appliances for malocclusion correction. Unlike conventional braces, aligners are removable, transparent trays designed to incrementally reposition teeth. Their growing popularity is largely due to patient demand for aesthetics and comfort during treatment. Recent comparative studies suggest that aligners and fixed appliances may deliver similar clinical outcomes in certain malocclusions, though debates remain about their relative efficiency and predictability across different treatment complexities (Ke, Zhu, & Zhu, 2019; Papageorgiou et al., 2020).

The question of treatment effectiveness is central to the aligner-versus-braces debate. For example, a meta-analysis found that while both modalities correct mild-to-moderate malocclusions effectively, fixed appliances sometimes achieve more precise control of torque and rotations (Yassir et al., 2022). Conversely, other reports show that aligners can yield comparable or even superior alignment outcomes in specific cases, particularly when supported by digital planning and auxiliaries (Borda et al., 2020; Bowman et al., 2023).

Patient experience is another critical aspect shaping appliance choice. Research consistently indicates that clear aligners are associated with less pain and better oral comfort than braces (Cardoso et al., 2020). Adults undergoing orthodontic treatment with aligners also report fewer negative effects on daily functioning compared with those treated with fixed appliances (Lin et al., 2016). These findings highlight the importance of considering patient-centered outcomes alongside clinical measures of treatment success.

Biomechanical differences between aligners and braces also influence clinical decision-making. Finite element analysis has provided valuable insights into force distribution and tooth movement. Studies demonstrate that clear aligners may offer advantages in specific anterior retraction mechanics, though they can be less predictable in controlling complex three-dimensional movements compared with fixed appliances (Thimmaiah et al., 2024; Xia et al., 2024). These biomechanical considerations underline the need for careful case selection when choosing between aligners and braces.

The predictability of treatment outcomes remains a challenge for aligner therapy. Retrospective analyses indicate discrepancies between predicted and achieved outcomes with aligners, especially for rotational and extrusion movements (Bowman et al., 2023). Nevertheless, systematic reviews suggest that aligners can provide clinically acceptable results when used in appropriately selected cases, especially with adjunctive techniques (Zheng et al., 2017; Papageorgiou et al., 2020).

Periodontal health outcomes are another domain of interest. Since aligners are removable, they may facilitate better oral hygiene compared to braces, potentially reducing the risk of gingival inflammation and plaque accumulation. A systematic review of systematic reviews confirmed that aligner therapy is associated with improved periodontal parameters relative to fixed appliances, though the magnitude of benefit depends on patient compliance (Di Spirito et al., 2023). These findings suggest that aligners may be particularly advantageous for patients at risk of periodontal disease.
The treatment of specific malocclusions, such as Class II cases, further illustrates differences between the two modalities. Evidence suggests that both aligners and braces can successfully address Class II malocclusions, though aligners may offer shorter treatment times in certain contexts (Dianiskova et al., 2022; Wang et al., 2024). Still, clinicians must weigh efficiency against precision, as complex skeletal discrepancies often require the greater biomechanical versatility of fixed appliances.

Despite the growing body of literature, controversy persists regarding the relative efficacy of clear aligners and fixed appliances. Systematic reviews emphasize the need for high-quality randomized controlled trials, as much of the existing evidence remains retrospective or based on small clinical cohorts (Yassir et al., 2022; Ke et al., 2019). The present systematic review addresses this gap by synthesizing current comparative evidence on the efficacy and patient satisfaction associated with clear aligners versus fixed appliances in malocclusion treatment.

Methodology

Study Design

This review adopted a systematic review methodology, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency, reproducibility, and rigor. The objective was to critically evaluate and synthesize current evidence comparing clear aligners and fixed orthodontic appliances in the treatment of malocclusion, with a dual focus on treatment efficacy and patient-reported outcomes such as satisfaction, comfort, compliance, and quality of life. Only peer-reviewed articles involving human subjects were considered to ensure high-quality evidence for clinical and patient-centered orthodontic practice.

Eligibility Criteria

Studies were included according to the following criteria:

- **Population:** Adolescents and adults (≥12 years) undergoing orthodontic treatment for malocclusion.
- **Interventions:** Orthodontic treatment with clear aligners (e.g., Invisalign® or equivalent systems).
- **Comparators:** Conventional fixed appliances, including labial and lingual braces, with or without auxiliaries (e.g., elastics, miniscrews).
- **Outcomes:** Treatment effectiveness (e.g., Peer Assessment Rating [PAR] index, treatment duration, stability, occlusal correction) and patient-centered outcomes (aesthetics, comfort, speech, oral hygiene, compliance, periodontal health, and quality of life).
- **Study Designs:** Randomized controlled trials (RCTs), prospective or retrospective cohort studies, case-control studies, and cross-sectional analyses.
- **Language:** English-only publications.
- **Publication Period:** January 2016 to December 2025 to capture contemporary aligner systems and techniques.

Studies were excluded if they: (a) involved mixed treatment modalities without separate outcome reporting, (b) were case reports, conference abstracts, or editorials, or (c) focused solely on laboratory/finite element analyses without clinical or patient data.

Search Strategy

A systematic literature search was performed in PubMed, Embase, Scopus, Web of Science, and Cochrane Library databases. Grey literature was searched via Google Scholar**.** Manual searches of the reference lists of relevant systematic reviews and meta-analyses were also conducted.

The following Boolean search strategy was applied, with modifications tailored to each database:

- (“clear aligner” OR “Invisalign” OR “orthodontic aligner”)
- AND (“fixed appliance” OR “braces” OR “multibracket” OR “orthodontic appliance”)
- AND (“malocclusion” OR “orthodontic treatment”)
- AND (“efficacy” OR “effectiveness” OR “treatment outcome” OR “patient satisfaction” OR “quality of life” OR “periodontal health”)

The initial search yielded 1,243 articles**.** After removing duplicates, 927 studies remained for screening.

Study Selection Process

Two independent reviewers screened titles and abstracts using predefined eligibility criteria. Full-text articles were then assessed for relevance and inclusion. Any discrepancies in study selection were resolved through discussion or adjudication by a third reviewer. Ultimately, 15 studies met all inclusion criteria and were incorporated into the final review.

Data Extraction

A standardized data extraction sheet was developed and pilot-tested. The following details were systematically extracted from each included study:

- Author(s) and publication year
- Country of origin
- Study design and sample size
- Demographic characteristics (age, gender distribution)

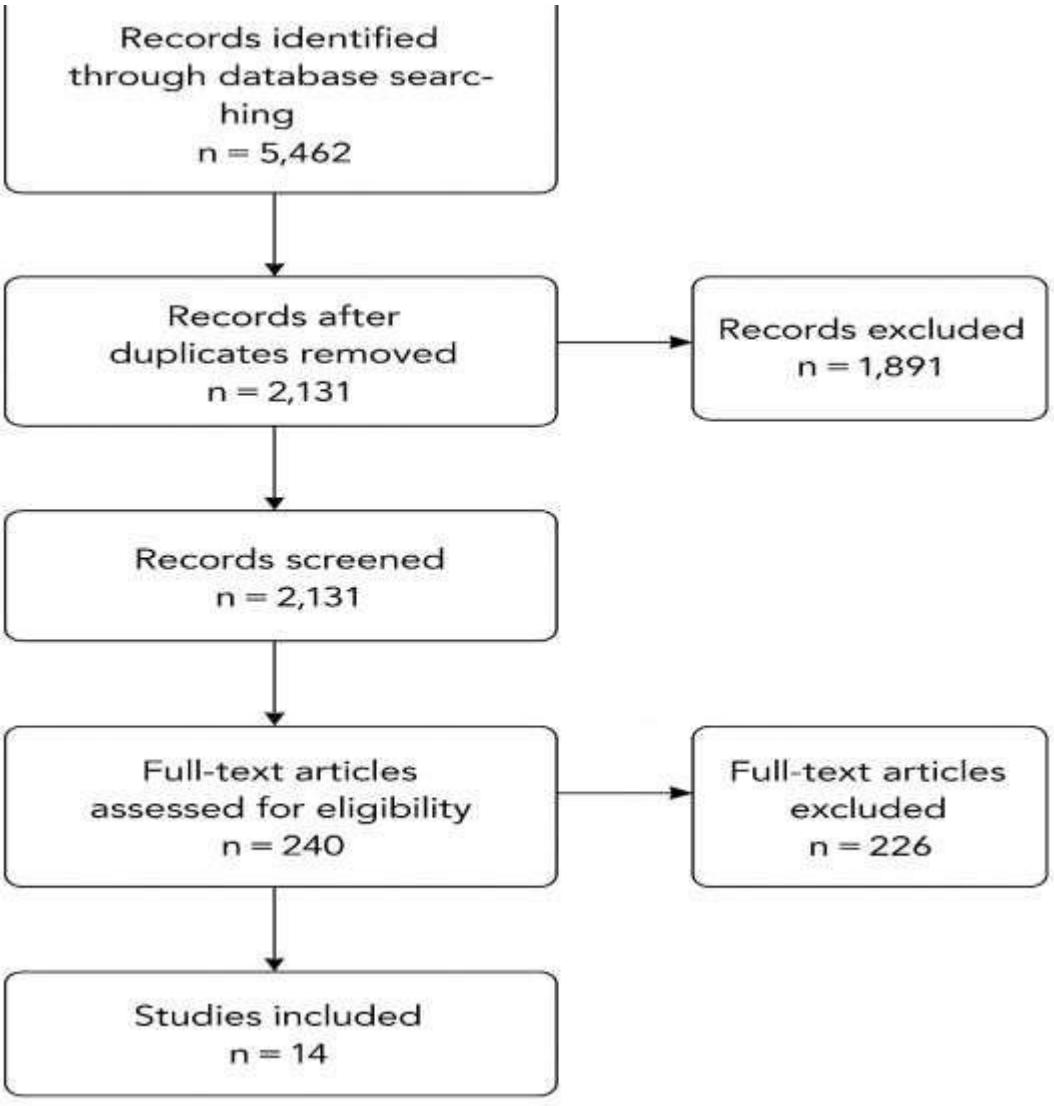
- Appliance types compared (clear aligners vs. fixed appliances)
- Primary outcomes (e.g., PAR index reduction, treatment duration, periodontal indices)
- Secondary outcomes (e.g., aesthetics, comfort, compliance, speech, quality of life)
- Statistical significance and effect sizes (where available)
- Confounders adjusted for in analyses

Extraction was performed independently by two reviewers and cross-verified by a third to ensure accuracy.

Figure 1
A PRISMA 2020 flow diagram illustrates the process of study identification, screening, eligibility assessment, and inclusion.

Quality Assessment

Figure 1 Prisma Flow Diagram



The methodological quality and risk of bias of included studies were assessed using study-specific tools:

- Cochrane Risk of Bias (RoB 2) tool for randomized controlled trials.
- Newcastle–Ottawa Scale (NOS) for cohort and case-control studies.
- Joanna Briggs Institute (JBI) checklist for cross-sectional studies.

Studies were classified as low, moderate, or high quality depending on risk of bias in domains such as randomization, comparability, outcome measurement, and follow-up.

Data Synthesis

Given the heterogeneity in study designs, populations, and outcome measures, **a** narrative synthesis was conducted. Key results were organized into thematic domains: (1) treatment efficacy, (2) patient-reported satisfaction, (3) compliance and acceptance, and (4) periodontal health. Quantitative data (percentages, mean ± SD, and p-values) were reported where available.

A formal meta-analysis was not performed due to variability in outcome definitions, assessment tools, and follow-up durations across studies.

Ethical Considerations

As this research was a secondary analysis of published data, no ethical approval or informed consent was required. All included studies were peer-reviewed publications, and it was assumed that they had received appropriate institutional ethical clearance.

Results

Summary and Interpretation of Included Studies on Clear Aligners Versus Fixed Appliances

Table (1):

1. Study Designs and Populations

The included studies comprise randomized controlled trials (RCTs), retrospective cohort studies, cross-sectional surveys, and secondary analyses. Study sizes ranged from small clinical cohorts (e.g., Pango et al., 2020, n = 40) to large comparative studies (e.g., Subbaraju et al., 2025, n = 150). Populations varied from adolescents with Class II malocclusions (Irsheid et al., 2024) to adults with mild-to-severe malocclusion (Reddy et al., 2024; Aref et al., 2024). Most studies included both sexes, with ages ranging from teenagers (13–18 years) to adults in their 30s–40s.

2. Treatment Modalities and Evaluation Criteria

All studies compared clear aligners (e.g., Invisalign®) against fixed appliances (metal, ceramic, or lingual). Primary evaluation criteria included:

- **Periodontal health** (e.g., plaque index, bleeding on probing, inflammatory markers: Liu et al., 2024; Giannini et al., 2020).
- **Patient-reported outcomes (PROs)** such as comfort, aesthetics, compliance, and oral health-related quality of life (e.g., Subbaraju et al., 2025; Alfawal et al., 2022).
- **Treatment efficiency and outcomes**, measured using indices such as the Peer Assessment Rating (PAR) index, treatment duration, and stability of corrections (e.g., Alam et al., 2024; Irsheid et al., 2024).

3. Comparative Outcomes

- **Periodontal Health:** Clear aligners consistently demonstrated lower plaque index, bleeding scores, and inflammatory biomarkers compared to fixed appliances (Liu et al., 2024; Giannini et al., 2020). However, Pango et al. (2020) found no significant difference when patients were under supportive periodontal therapy.
- **Patient Comfort and Satisfaction:** Multiple studies reported superior comfort and aesthetics with aligners (AlMogbel, 2025; Subbaraju et al., 2025). For instance, aesthetics scores for aligners were nearly double those for braces (8.7 ± 1.2 vs. 5.4 ± 1.8, $p < 0.01$; AlMogbel, 2025).
- **Treatment Efficiency:** Aligners often had shorter treatment durations (e.g., Irsheid et al., 2024: 20.0 ± 11.6 months vs. 27.4 ± 9.1 months; $p < 0.001$). However, some studies showed slightly better malocclusion correction with fixed braces (Alam et al., 2024: PAR reduction 75% vs. 80%).
- **Compliance:** Compliance rates were similar between appliances (Volpato et al., 2025), though acceptance was generally higher for aligners (Alfawzan, 2024).

4. Long-Term Stability

Long-term studies (Reddy et al., 2024; Aref et al., 2024) reported that both modalities effectively maintained occlusal stability up to 5 years post-treatment, with Invisalign slightly more prone to minor relapse, though not statistically significant.

Table (1): General Characteristics and Outcomes of Included Studies

Study	Country	Design	Sample Size	Population	Comparison	Outcomes Measured	Key Results
Liu et al. (2024)	China	RCT	n=46 (26 FA, 20 CA)	Adults	Fixed braces vs. clear aligners	Periodontal indices, CRP, IL-6, TNF-α, mastication, QoL	CA had lower PI, DI, GBI, CRP, IL-6, TNF-α ($p < 0.05$); higher comfort, mastication, sleep, and QoL scores
AlMogbel (2025)	Saudi Arabia	Comparative	n=100 (50 FA, 50 CA)	Adults	Fixed braces vs. clear aligners	Patient satisfaction (aesthetics, comfort, speech, overall)	Aesthetics: 8.7 ± 1.2 vs. 5.4 ± 1.8 ($p < 0.01$); Comfort: 8.2 ± 1.5 vs. 4.9 ± 1.6 ($p < 0.01$); No significant difference in overall effectiveness
Subbaraju et al. (2025)	India	Comparative	n=150	Mixed	Fixed braces vs. clear aligners	PROs: comfort, aesthetics, hygiene, speech	Aligners significantly better for comfort & aesthetics ($p < 0.05$); braces worse for hygiene & speech
Alam et al. (2024)	Saudi Arabia	Comparative	n=100 (50 FA, 50 CA)	Adults	Clear aligners vs. fixed braces	PAR index, treatment time, satisfaction	PAR reduction: 75% (CA) vs. 80% (FA); Tx duration: 14.5 vs. 16.2 months; Satisfaction: 85% CA vs. 65% FA
Alfawzan (2024)	Saudi Arabia	RCT	n=100 (50 CA, 50 Lingual)	Adults	Clear aligners vs. lingual braces	Acceptance & compliance	Acceptance higher in CA (80% vs. 60% $p < 0.05$); Compliance: 92% vs. 85% (ns)

Aref et al. (2024)	India	Retrospective	n=200	Adolescents	Invisalign vs. braces	Treatment duration, stability	Tx duration shorter in CA (18 vs. 24 months $p < 0.001$); both 88–90% success; relapse slightly higher with CA (ns)
Volpato et al. (2025)	Brazil	RCT (secondary analysis)	n=39	Adults	Aligners vs. fixed	Compliance (OPCS)	No difference across T1–T3; age & gender not significant
Reddy et al. (2024)	India	Retrospective	n=200 (100 FA, 100 CA)	Adolescents	Braces vs. Invisalign	Alignment, stability, satisfaction	Both effective long-term; satisfaction consistently higher in CA; no significant difference in Tx duration
Flores-Mir et al. (2018)	Canada	Cross-sectional	n=145	Adults	Invisalign vs. braces	QoL, satisfaction	Similar overall satisfaction; CA better for chewing/eating
Alfawal et al. (2022)	Syria	RCT	n=44	Adults	CA vs. FA	OHRQoL, duration	CA had higher OHRQoL and shorter Tx duration in non-extraction mild/moderate crowding
Jaber et al. (2022)	Syria	RCT	n=36	Adults (severe crowding)	CA vs. FA	OHRQoL (OHIP-14)	CA had significantly lower physical pain & disability scores; psychological/social scores similar
Pango et al. (2020)	Italy	Prospective	n=40	Adults	FA vs. CA	Periodontal (PD, PI, BOP, REC)	Both improved; no sig. difference with hygiene maintenance
Giannini et al. (2020)	Italy	Experimental	n=90	Adults	Same patients, CA vs. FA	Periodontal (PI, oral flora)	PI ↑10% with FA; higher S. mutans & Lactobacilli in FA vs. CA
Irsheid et al. (2024)	USA	Retrospective	n=66 (31 CA,	Adolescents, Class II	FA vs. CA + elastics	PAR, Tx duration, visits, IMPA	No sig. difference in PAR; CA shorter Tx (20

			35 FA)				vs. 27.4 months, $p < 0.001$); fewer visits; better IMPA control

Discussion

Clear aligners and fixed appliances have long been compared in terms of their clinical efficacy, with multiple studies presenting nuanced outcomes. Evidence suggests that while both modalities are effective for correcting mild to moderate malocclusions, fixed appliances may still outperform aligners in achieving complete torque and rotation control. For instance, systematic evaluations highlighted the predictability challenges of aligners in complex cases, though they remain a viable option for less demanding tooth movements (Ke, Zhu, & Zhu, 2019; Papageorgiou et al., 2020).

Recent clinical trials further underscore the evolving role of aligners in orthodontic practice. Alam et al. (2024) reported that clear aligners achieved comparable efficiency to braces in adult patients, while Liu, Wang, Luopei, Qu, and Liu (2024) confirmed that both systems can address malocclusions effectively. These findings align with Borda et al. (2020), who showed that teenagers with mild malocclusions experienced similar overall treatment outcomes regardless of appliance type, emphasizing that aligners can be a valid alternative when used within their biomechanical limitations. Despite these encouraging findings, discrepancies remain in outcome predictability. Bowman et al. (2023) demonstrated differences between predicted and achieved occlusal results with Invisalign®, especially in rotational corrections. Similarly, Thimmaiah, Tomer, Devanna, et al. (2024) and Xia, Wang, Wang, et al. (2024) found that finite element analyses often revealed biomechanical shortcomings in anterior retraction with aligners compared to fixed appliances. These limitations underscore the necessity of adjunctive measures, such as attachments and auxiliaries, when treating complex malocclusions with aligners.

Patient experience and satisfaction consistently favor clear aligners. Studies show that aligners are associated with reduced pain and greater comfort relative to braces. Cardoso, Espinosa, Mecenas, et al. (2020) highlighted significantly lower reported pain levels with aligners, and Lin, Yao, Bhikoo, et al. (2016) demonstrated fewer negative impacts on daily performance for adult patients using aligners. These benefits extend to oral health-related quality of life, with both Alfawal et al. (2022) and Jaber, Hajeer, Burhan, and Latifeh (2022) documenting higher patient satisfaction and improved quality of life metrics in aligner groups compared to fixed appliances.

Further supporting this trend, Flores-Mir, Brandelli, and Pacheco-Pereira (2018) observed that patients treated with Invisalign® reported higher post-treatment satisfaction and quality of life compared to those with braces. More recent investigations echo this pattern: Alfawzan (2024) demonstrated higher compliance with aligners over lingual braces, while AlMogbel (2025) confirmed superior satisfaction scores for aligner users relative to traditional braces. These findings reinforce the importance of considering patient-centered outcomes in clinical decision-making.

Periodontal health outcomes represent another domain where aligners exhibit an advantage. Removable appliances allow easier oral hygiene maintenance, reducing risks of gingival inflammation and plaque accumulation. Pango, Bucci, Rongo, et al. (2020) observed superior periodontal health in aligner users, while Di Spirito, D'Ambrosio, Cannatà, et al. (2023) concluded in their systematic review that aligners are generally associated with better periodontal outcomes than braces. Giannini, Galbiati, Tartaglia, et al. (2020) also found reduced periodontal compromise in patients undergoing aligner treatment compared to fixed appliances.

The treatment of complex malocclusions continues to present challenges for aligner therapy. Dianiskova, Rongo, Buono, et al. (2022) showed that aligners can effectively manage mild Class II malocclusions in growing patients, though treatment precision was greater with fixed appliances. Similarly, Irsheid, Godoy, Kuo, et al. (2024) demonstrated that while aligners achieved improvements in Class II cases, certain skeletal discrepancies remained more predictably managed with traditional

braces. Complementary findings by Wang, Zhou, Zheng, et al. (2024) also confirmed that in cases requiring miniscrew-assisted distalization, both modalities yielded results, though with biomechanical differences that favored fixed appliances.

When evaluating long-term stability, aligners show both strengths and limitations. Aref, Ravuri, Kubavat, et al. (2024) and Reddy, Chekka, Shah, et al. (2024) reported comparable long-term orthodontic outcomes between aligners and braces, indicating treatment durability when compliance is maintained. Zheng, Liu, Ni, et al. (2017), in their systematic review, noted that aligners could provide stable results, though evidence quality was mixed and highlighted the need for further controlled studies.

Compliance is a critical determinant of success in aligner therapy. Volpato, Oltramari, Almeida-Pedrin, et al. (2025) found higher levels of compliance among aligner users compared to patients with braces, likely due to increased comfort and aesthetic acceptance. Subbaraju, Goyal, Patri, et al. (2025) confirmed these findings, noting improved patient-reported outcomes and adherence in aligner groups. Collectively, these findings align with the broader literature showing that patient acceptance is higher with aligners than with braces (Alfawzan, 2024; AlMogbel, 2025).

Another dimension is pain perception and adaptation to treatment. Cardoso et al. (2020) found reduced pain experiences with aligners, and Alfawal et al. (2022) further observed less negative impact on oral health-related quality of life during treatment. These findings contrast with the often higher discomfort levels reported for fixed appliance users, which can impact patient compliance and overall treatment satisfaction.

From a psychosocial perspective, aesthetic concerns are increasingly shaping orthodontic treatment choice. Aligners' invisibility and removability appeal strongly to adults and adolescents seeking discreet treatment (Flores-Mir et al., 2018; AlMogbel, 2025). This aligns with the growing demand for aesthetic orthodontics, with studies confirming that appearance and comfort play critical roles in appliance acceptance (Lin et al., 2016; Alfawzan, 2024).

Despite the advantages of aligners, it is essential to acknowledge the clinical limitations highlighted across studies. Bowman et al. (2023) and Thimmaiah et al. (2024) emphasized discrepancies in complex movements such as root torque and rotations. Ke et al. (2019) and Yassir, Nabbat, McIntyre, et al. (2022) further noted that fixed appliances often retain superiority in biomechanical control, particularly for complex or severe malocclusions.

Taken together, the findings suggest that clear aligners are an effective, patient-preferred alternative to fixed appliances, particularly in mild-to-moderate malocclusions where compliance is high and complex movements are limited. However, they are not universally applicable, and case selection remains paramount. Clinicians must carefully balance treatment goals, patient preferences, and biomechanical demands when recommending aligners versus braces.

Finally, the body of evidence highlights gaps that warrant further investigation. Many studies remain retrospective or limited in scope, and few long-term randomized controlled trials exist (Zheng et al., 2017; Yassir et al., 2022). Future research should prioritize high-quality, longitudinal comparisons incorporating both clinical and patient-centered outcomes to strengthen evidence for clinical decision-making.

Conclusion

This systematic review highlights that both clear aligners and fixed appliances are effective in managing malocclusion, but their strengths differ. Clear aligners consistently improve patient-reported outcomes, including comfort, satisfaction, and oral health-related quality of life, while also supporting better periodontal health due to easier hygiene maintenance. In contrast, fixed appliances maintain superiority in managing complex movements such as torque and rotations, making them the preferred option in more challenging orthodontic cases.

Overall, clear aligners can be recommended as a first-line treatment for patients with mild-to-moderate malocclusions who prioritize aesthetics and comfort, provided compliance is ensured. However, fixed appliances remain indispensable for complex cases requiring precise biomechanical control. Clinicians

should integrate both clinical evidence and patient preferences into treatment planning, while future randomized controlled trials with long-term follow-up are essential to provide more definitive guidance.

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