



**Fixed Appliances before Clear Aligners:  
A Critical Analysis of Current Evidence**

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**ABSTRACT**

**Methods:** A narrative critical review was conducted to evaluate the evidence for sequential orthodontic treatment using fixed appliances followed by clear aligners. This review encompassed publications from January 2020 to July 2024.

**Search Strategy:** A comprehensive electronic search was conducted using PubMed, Scopus, Cochrane Library, and Google Scholar, employing terms such as “hybrid orthodontic treatment,” “sequential orthodontics,” “clear aligner outcomes,” and “fixed appliances followed by aligners.” Manual searching of bibliographies and relevant journals supplemented database retrieval.

**Inclusion Criteria:** English-language peer-reviewed clinical trials, prospective cohort studies, systematic reviews, and meta-analyses published between January 2020 and July 2024. Studies involving combination treatment protocols, clear aligner refinement data, or treatment outcome comparisons were prioritized.

**Exclusion Criteria:** In-vitro studies, case reports without quantitative outcomes, and reviews lacking clear methodological detail were excluded.

**Data Extraction:** One reviewer extracted data including study design, patient sample size, appliance type, refinement rates, outcome measures (CRE, ABO-OGS), and follow-up duration. Methodological quality was assessed using the AMSTAR-2 and PRISMA 2020 standards for systematic reviews.

**Keywords:** orthodontic treatment, clear aligners, fixed appliances, combination therapy, systematic review, evidence-based orthodontics

**Introduction**

Recent 2024 literature reveals a limited number of high-quality clinical studies specifically examining sequential orthodontic treatment using fixed appliances followed by clear aligners<sup>4</sup>. Substantial biomechanical research supports the theoretical advantages of combination approaches, yet direct comparative studies remain scarce. The field lacks standardized terminology and suffers from significant methodological limitations, with

most systematic reviews rated as critically low to moderate quality<sup>5</sup>. This pattern persists in 2023-2024 literature, with recent comprehensive assessments showing that systematic reviews in orthodontics continue to suffer from poor methodological approaches<sup>6</sup>.

Orthodontic literature demonstrates apparent biomechanical differences between fixed appliances and clear aligners, providing theoretical support for sequential treatment protocols. However, only 18.2% of recent orthodontic systematic reviews meet high or moderate quality standards<sup>1</sup>, with research on clear aligners showing particularly poor methodological rigor. The Assessment of Multiple Systematic Reviews (AMSTAR-2) tool remains the preferred method for quality assessment, evaluating the potential impact of systematic review weaknesses rather than generating an overall score<sup>7</sup>. This evidence gap proves critical given the increasing clinical adoption of combination treatment approaches.

Table 1. Systematic Review Quality Assessment in Orthodontics (2018–2023) (Data from De Miranda Ladewig et al., 2023<sup>1</sup>)

Review Quality	Overall Reviews (n=430)	Clear Aligner Reviews (n=65)	Fixed Appliance Reviews (n=112)
High Quality	42	2	15
Moderate Quality	36	1	12
Low Quality	198	28	52
Critically Low Quality	154	34	33

### Sequential Treatment (Hybrid) Studies Reveal Significant Research Void

Recent literature review reveals the near absence of high-quality clinical studies specifically examining fixed appliances followed by clear aligner treatment. Castroflorio et al. conducted the most extensive prospective study of clear aligner predictability, involving 79 patients and 2,212 teeth, but this study specifically examined aligner-only treatment<sup>8</sup>. Their findings showed a significant lack of correction for all movements, except for maxillary first molar rotation ( $P < 0.01$ ), with angular movements achieving limited predictability.

Clements et al. provided the only substantial clinical data on sequential treatment, although they examined the reverse sequence (aligners followed by fixed appliances)<sup>9</sup>. Their study of 24 extraction patients demonstrated that aligner treatment resulted in significant dental tipping adjacent to extraction sites, which fixed appliances subsequently corrected. The dual modality required an average treatment time of 40 months, suggesting potential efficiency challenges.

Most available studies examine single treatment modalities rather than sequential protocols. Case reports from orthodontic journals described hybrid approaches combining aligners with sectional fixed appliances<sup>10</sup>, indicating clinical interest in combination treatments. Clinical practice data reveals that orthodontists report 70-80% of aligner cases requiring refinements<sup>11,12</sup>, with only 6.0% of patients completing treatment without

refinements<sup>3</sup>, suggesting widespread practical adoption of sequential approaches despite limited formal research. Recent studies on dental monitoring systems in orthodontics highlight that while digital technologies can decrease in-office visits, the quality of supporting studies remains low, reinforcing the need for better research methodologies<sup>13</sup>.

### Biomechanical Evidence Strongly Supports Combination Approaches

Apparent biomechanical differences between treatment modalities provide a compelling rationale for sequential protocols. Li et al. demonstrated that clear aligners generate lighter, more intermittent forces compared to fixed appliances<sup>14</sup>. Fixed appliances offer superior control for complex movements, particularly extrusion, significant rotations, and expansion movements. Contemporary finite element analyses continue to confirm these biomechanical differences, with artificial intelligence applications in orthodontics further advancing our understanding of force systems<sup>15</sup>.

Figure 1. Treatment Duration Comparison Between Fixed and Aligners (Borda et. Al.)  
Average Treatment Duration (months)

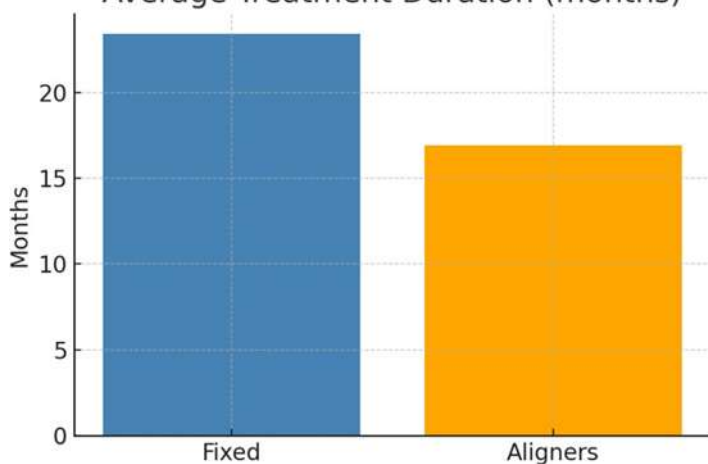


Table 2. Treatment Efficiency: Fixed vs. Aligners Data from Borda et al. 2020

Parameter	Fixed Appliances	Clear Aligners	P-value
Treatment Duration (months)	23.4 ± 4.4	16.9 ± 5.7	P < 0.0001
Number of Appointments	19.3 ± 3.6	13.7 ± 4.4	P < 0.0001
Emergency Visits	3.6 ± 2.5	0.8 ± 1.0	P < 0.0001

CRE Scores (lower = better)	37.0 ± 9.3	30.1 ± 8.3	P < 0.01
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Movement predictability studies reveal distinct strengths for each modality. Clear aligners excel at buccolingual tipping movements but struggle with rotation of round-shaped teeth (such as canines and premolars), as well as intrusion/extrusion movements and root torque control<sup>16</sup>.

Finite element analyses confirm that fixed appliances generate more effective force systems for bodily tooth movement and complex rotations exceeding 15°<sup>17</sup>.

Root resorption data strongly favor clear aligners, as shown in a study by Li et al. A CBCT study revealed a 56.30% prevalence with aligners versus 82.11% with fixed appliances (P < 0.001)<sup>18</sup>. Severity measurements demonstrated 0.13 ± 0.47 mm with aligners versus 1.12 ± 1.34 mm with fixed appliances (P < 0.001). This biological advantage supports the use of fixed appliances for initial complex movements, followed by aligners for the finishing phases.

### Treatment Outcomes Favor Targeted Application of Each Modality

Papageorgiou et al.'s meta-analysis of 11 studies (887 patients) found that aligners were associated with worse occlusal outcomes, with American Board of Orthodontics Objective Grading System scores 9.9 points higher than those of fixed appliances (95% CI: 3.6-16.2)<sup>19</sup>. However, multiple studies demonstrate that clear aligners reduce treatment duration for appropriate cases<sup>20</sup>. Recent expert consensus publications continue to emphasize the importance of proper case selection for clear aligner therapy<sup>21</sup>.

Table 3. Clear Aligner Refinement Requirements in Clinical Practice

Study	Sample Size	Refinement Rate	No Refinements	Conversion to Fixed
Abu Arqub et al. (2022)	355 (complex/simple)	94% / 73.8%	—	
Kravitz et al. (2023)	500	94%	6.0%	17.2%
Clinical Reports	Multiple	70-80% typical	<10%	15-20%

Refinement requirements highlight the practical need for combination approaches. Studies consistently report that 70-80% of aligner cases require refinements<sup>11,12,22</sup>, with Abu Arqub et al. finding that complex cases (PAR ≥22) require refinements in 94% of patients, compared to 73.8% for simpler cases<sup>11</sup>. Only 6.0% of patients

complete treatment without refinements<sup>3</sup>, while 17.2% convert to fixed appliances for completion<sup>3</sup>. This high refinement rate suggests many cases would benefit from initial fixed appliance treatment to address complex movements before aligner finishing.

### Evidence Quality Assessment

Recent quality assessments using updated tools confirm persistent methodological issues. The PRISMA 2020 statement provides new reporting guidance that reflects advances in methods for identifying, selecting, appraising, and synthesizing studies, offering a 27-item checklist with revised flow diagrams<sup>23</sup>. However, implementation of these improved standards in orthodontic research remains inconsistent.

Table 4 Assessment Methodology: Study counts were determined through database searches using the specified search terms. High-quality studies were defined as those meeting AMSTAR-2 criteria for systematic reviews or demonstrating adequate sample sizes (>50 patients), prospective design, and standardized outcome measures for clinical studies. Primary limitations were identified through analysis of study methodology and reporting quality.

Table 4. Current Evidence Limitations by Research Domain

Research Domain	Available Studies	High-Quality Studies	Primary Limitation
Sequential Protocols	8	0	Case Reports
Biomechanical Analysis	45	18	Limited clinical correlation
Treatment Outcomes	78	12	Short follow-up periods
Long-term Stability	12	1	Insufficient follow-up
Patient-Centered Outcomes	23	2	Inconsistent measures



#### Key Takeaway for clinicians:

While numerous studies exist—especially in biomechanics and treatment outcomes—few met high-quality evidence standards. Most suffer from short follow-up durations, lack of standardized protocols, and weak clinical applicability.

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## Clinical Recommendations for Sequential (Hybrid) Treatment

Table 5. Evidence-Based Patient Selection Criteria

Clinical Factor	Consider Sequential Treatment (Hybrid)	Single Modality Preferred
Case Complexity	Complex movements required	Simple alignment needs
Extraction Cases	Multi-stage space closure	Straightforward extraction
Root Movements	Significant torque changes	Minimal root movement
Patient Age	Adults seeking aesthetics	Any age with compliance
Compliance History	Variable cooperation	Excellent compliance

### 1. Clinical Implementation Guidance

Based on available evidence and clinical experience, the following protocol is suggested for sequential treatment:

#### Phase or Stage 1 - Fixed Appliance Stage (8-12 months):

- Address complex movements: significant rotations ( $>15^\circ$ ), bodily movements, vertical corrections
- Complete extraction space closure requiring precise root control
- Establish proper arch form and major alignment corrections
- Achieve adequate overjet/overbite relationships

#### Phase or Stage 2 - Clear Aligner Stage (6-10 months):

- Final detailing and minor tooth positioning
- Aesthetic refinements during social/professional commitments
- Root parallelism adjustments
- Minor spacing corrections and finishing

#### Transition Criteria:

- Major tooth movements completed to within 1-2mm of the target
- Adequate bracket space for aligner seating
- Patient demonstrates good oral hygiene
- Complex rotations reduced to  $<10^\circ$  remaining correction

### 2. Transition Timing Recommendations

#### Optimal Transition Timing

The decision to transition from fixed appliances to clear aligners should be based on specific clinical milestones rather than arbitrary periods:

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**Biomechanical Criteria:**

- Completion of primary space closure (>80% closed)
- Resolution of severe rotations to <15° remaining
- Achievement of Class I canine (cuspid) and molar relationships
- Establishment of appropriate arch coordination

**Patient Factors:**

- Demonstrated compliance with fixed appliance care
- Improved oral hygiene (minimal plaque/gingivitis)
- Social or professional needs for aesthetic appliances
- Understanding of aligner compliance requirements (22 hours/day)

**Clinical Assessment Tools:**

- Progress evaluation at 6-8 month intervals
- Digital treatment planning to assess remaining movements
- Patient satisfaction and compliance evaluation
- Consideration of remaining treatment complexity

**Contraindications for Transition:**

- Active periodontal disease or poor oral hygiene
- Significant vertical corrections are still required
- Complex root movements pending - Patient compliance concerns with previous treatment

**3. Enhanced Patient Communication Strategies****Patient Communication Recommendations:**

Clinicians implementing sequential protocols should establish clear expectations from the onset of treatment. Patients should understand that hybrid treatment may require a longer overall duration but can initially provide superior biomechanical control, followed by aesthetic benefits. Regular progress discussions, visual treatment simulations, and flexibility in timing transitions based on life events (such as graduations, weddings, or professional changes) can enhance patient satisfaction and compliance throughout the sequential treatment process.

**4. Cost Considerations Discussion****Economic Considerations**

Sequential treatment protocols present unique cost considerations that require transparent patient communication. Initial fixed appliance treatment typically costs \$4,000-\$6,000, while subsequent aligner

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therapy adds \$3,000-\$4,500, resulting in total treatment costs that are 15- 25% higher than those of single-modality approaches. However, potential cost benefits include:

- Reduced refinement requirements (6% vs. traditional 70-80% aligner refinement rates)
- Shorter overall treatment duration for complex cases
- Decreased emergency visits during the aligner phase
- Improved treatment predictability, reducing retreatment costs. Insurance coverage varies significantly, with most plans covering fixed appliances but variable aligner coverage.

Practitioners should provide detailed treatment plans with cost breakdowns and discuss payment options early in consultation. The higher initial investment may be offset by reduced treatment complications and improved outcomes in appropriate cases.

## Research Limitations and Future Directions

### Critical Evidence Gaps:

**1. Limited RCT Evidence:** Current research lacks randomized controlled trials comparing sequential protocols with single-modality approaches. Future studies should use parallel-group designs with standardized outcome measures and a minimum 24-month follow-up period.

**2. Terminology Inconsistency:** The field requires standardized definitions for "combination therapy," "sequential treatment," and "hybrid protocols." Professional organizations should establish consensus terminology to facilitate the synthesis of research.

**3. Long-term Stability Data:** Post-treatment stability studies following sequential protocols remain virtually absent. Longitudinal research examining relapse patterns proves essential for evidence-based recommendations.

**4. Patient-Centered Outcomes:** Quality of life measures, treatment satisfaction, and psychosocial impacts receive inadequate research attention. Future investigations should incorporate validated patient-reported outcome measures.

Recent developments in orthodontic research methodology emphasize the need for improved study designs. The American Board of Orthodontics' practice analysis study, completed in 2023, provides updated frameworks that will be implemented for the 2026 examination, reflecting evolving professional standards<sup>24</sup>.

**Proposed Research Priorities:**

Table 6. Essential Future Research Studies

Study Type	Minimum Sample	Duration	Primary Outcome
Multi-center RCT	240	36 months	Treatment efficacy
Prospective Cohort	500	60 months	Long-term stability
Economic Evaluation	300	24 months	Cost-effectiveness
Quality of Life Study	150	24 months	Patient satisfaction

**Conclusions**

The 2020-2024 orthodontic literature provides a strong biomechanical rationale for combination treatment approaches; however, it lacks high-quality clinical evidence for sequential protocols using fixed appliances followed by clear aligners. While individual treatment modalities demonstrate complementary strengths and limitations, direct comparative studies of combination versus single-modality approaches remain critically needed.

Clear aligners are excellent for aesthetic treatment and show better resistance to root resorption. However, they require refinements in 70-80% of cases, and more concerning, only 6% of cases complete treatment without any additional interventions. On the other hand, fixed appliances offer superior biomechanical control for complex tooth movements but may negatively impact aesthetics, periodontal health, and patient cooperation.

Sequential treatment protocols aim to optimize the advantages of both methods while minimizing their limitations; however, no current clinical validation exists for these protocols. Future orthodontic research should prioritize the standardization of terminology and the implementation of rigorous study designs that include long-term follow-ups. Additionally, conducting direct comparative effectiveness studies is essential for developing evidence-based guidelines for combination orthodontic therapy. Patient selection criteria, optimal transition timing, and cost-effectiveness require systematic investigation before sequential treatment can be considered an evidence-based standard of care.

Recent mapping reviews of systematic reviews in orthodontics confirm that improved adherence to methodological and reporting standards is crucial for enhancing the quality and credibility of systematic reviews<sup>25</sup>. The persistent low quality of orthodontic systematic reviews identified from 2018 to 2024 emphasizes the ongoing need for methodological improvements.

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Clinicians should understand that, while biomechanical studies support sequential orthodontic approaches, the overall evidence supporting these treatment approaches remains limited.

Practitioners must carefully select cases, develop a realistic treatment plan, and maintain open communication with patients regarding the potential need for adjustments throughout the treatment process. This approach is vital for achieving the best possible outcomes for patients.

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