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Review Article

Efficiency of clear aligners vs fixed appliances: A narrative review

Prasad Konda[1], Naailah Faatima[1]*

[1]*Dept. of Orthodontics and Dentofacial Orthopaedics, Al-Badar Rural Dental College and Hospital, Kalaburagi, Karnataka, India*

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ABSTRACT

Clear aligner therapy has emerged as a popular alternative to traditional fixed orthodontic treatment, particularly among adult patients seeking aesthetic and comfortable options. These aligners, made of clear thermoformed plastic, offer advantages such as improved aesthetics, comfort, oral hygiene, and periodontal health compared to fixed appliances. Recent studies have shown that clear aligners can be equally effective as fixed appliances, if not more so, for treating mild to moderate malocclusions, with shorter treatment durations, fewer appointments, and reduced emergency visits. While clear aligners may not be as effective for complex cases requiring additional techniques, advancements in technology have expanded their applicability, allowing for the incorporation of methods used in traditional braces. However, more extensive research is needed to fully understand their impact on oral health and the oral microbiome, spanning all treatment phases from initiation to maintenance. Additionally, various brands of clear aligners with different materials and designs have entered the market, offering alternatives to the widely known Invisalign™, though scientific literature on these alternatives remains limited. This article discusses about the efficacy of clear aligners as compared to fixed appliances in orthodontic treatment.

1. Background

Malocclusion poses a prevalent oral health concern, impacting both orofacial function and long-term psychosocial well-being. Orthodontic therapy aims to correct malocclusion and craniofacial skeletal discrepancies while enhancing mastication and appearance.[1] However, the effects of orthodontic appliances on the oral microbiome and periodontal tissues must be considered. Inserting orthodontic appliances alters the structure of plaque biofilm, influencing dental and periodontal health significantly.[2] Removable appliances offer a solution by simplifying oral hygiene routines for patients.

In recent years, there has been a surge in adult patients seeking orthodontic treatment, demanding aesthetically pleasing and comfortable alternatives to traditional fixed equipment.[3] Clear aligners have emerged as a popular choice due to their transparency and flexibility; meeting patients' needs for comfort and aesthetics. The evolution of clear aligner therapy has been propelled by advancements in CAD-CAM technology and transparent thermoplastic materials, coupled with increased patient demand.[4] Nowadays, various brands of aligners are available, differing in material, wearing time, gingival margin design, and the presence of attachments and ancillaries. With the aid of tools like mini-screws, elastics, and expanders, clear aligners can now address more complex cases beyond simple malocclusions, marking a significant advancement in orthodontic treatment options.

* *Corresponding author*.
E-mail address: fnaailah26@gmail.com (N. Faatima).

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2. Search Methodology

We conducted a comprehensive search using databases such as PubMed, Google Scholar, Embase, and MEDLINE, utilizing the keywords "Clear Aligner Therapy", "Fixed Orthodontic Treatment", "Fixed appliances"' "Orthodontic advancements" and "Malocclusion." Our focus was on extracting all relevant clinical trials, systematic reviews, and meta-analyses. We included studies exclusively published in English. Initially, we excluded articles based on irrelevance in their titles. Subsequently, a thorough review of abstracts was undertaken, which further narrowed down the selection to the most pertinent studies concerning our subject matter from the year 2000-2024.

3. Review

3.1. The emergence of clear aligner therapy

With the rising number of adults seeking orthodontic treatment, there is a growing demand for more aesthetic and comfortable options than traditional braces. Clear Aligner Therapy (CAT) encompasses various appliances made from clear thermoformed plastic aligners, differing in action, construction, and applicability to different malocclusions. Initially designed for minor tooth adjustments, some systems now claim to address complex issues, though robust clinical evidence is often lacking. Despite this, many CAT systems are marketed directly to consumers, sometimes without any dental oversight. Some systems use resin attachments to expand their treatment capabilities. Rapid technological advancements in CAT materials and design complicate scientific assessment, as studies often become outdated before publication.[4]

3.2. Advantages of clear aligner therapy over fixed orthodontic treatment

Clear Aligner Therapy (CAT) offers several advantages over traditional braces, including fewer emergencies, enhanced aesthetics, comfort, better oral hygiene, and improved periodontal health. Emergencies are rare, as lost or damaged aligners can be replaced within two weeks while patients continue with their previous aligner.[5] Aesthetics are a primary concern for CAT patients, and the aligners' removability and discreetness contribute to superior comfort and reduced pain compared to fixed appliances. CAT is also beneficial for adult patients at risk of periodontitis, showing improved periodontal health over a 12-month period compared to fixed braces.[6,7] However, the efficiency of CAT in complex cases is less certain. Although it minimizes emergencies and chairside time, planning via ClinCheck can be time-consuming.[8] CAT is best suited for simple malocclusions, but more complex movements may require additional techniques such as attachments, pressure points, and intermaxillary elastics. Advanced aligner systems can incorporate methods used in traditional braces, like temporary anchorage devices and fixed expanders, to achieve better three-dimensional control and improved outcomes.[9]

3.3. Case studies highlighting the efficacy of clear aligners over fixed appliances

A study conducted by Borda et al. in 2020 assessed the efficacy and efficiency of treating mild malocclusions in adolescents using clear aligners versus fixed appliances. Retrospective data from a private practice included 26 patients per group treated with either Invisalign or Damon braces. Using the American Board of Orthodontics Discrepancy Index (DI) for initial records and Cast-Radiograph Evaluation (CRE) for final records, the study found no significant pretreatment severity differences between groups. Posttreatment, the aligner group had significantly fewer discrepancies from the ideal (CRE: 30.1 vs. 37.0; $P < .01$). Aligner patients also had fewer appointments (13.7 vs. 19.3; $P < .0001$), fewer emergency visits (0.8 vs. 3.6; $P < .0001$), and shorter overall treatment times (16.9 vs. 23.4 months; $P < .0001$). Thus, clear aligners were equally effective as fixed appliances for mild malocclusions but provided better efficiency in treatment.[10]

A study compared the efficacy and efficiency of clear aligners (CAT) versus fixed appliances (FAT) in adolescents with Class I and II moderate to severe malocclusions. Using records from 72 cases treated by a single operator from 2014 to 2019, the study evaluated discrepancy index (DI) and cast radiograph evaluation (CRE) scores, treatment duration, number of scheduled and emergency visits, and compliance with appliance and elastic wear. The results showed no significant differences in DI (CAT: 21, FAT: 24) or CRE (CAT: 35, FAT: 34) scores between the groups, nor in appliance and elastic wear compliance. However, CAT cases had significantly shorter treatment durations (24 vs. 27 months; $P = .01$) and fewer visits (16 vs. 24; $P < .01$), while the number of emergency visits was similar (2 vs. 3; $P = .08$). Thus, CAT completed treatment faster with fewer visits, without compromising efficacy compared to FAT.[11]

A study retrospectively evaluated the dentoskeletal effects of clear aligners (Invisalign) versus miniplate-supported posterior intrusion (MSPI) in adults with anterior open bite and identified factors associated with posttreatment overbite. Data from 29 Invisalign and 24 MSPI patients from five orthodontic practices were analyzed using pretreatment and posttreatment cephalometric measurements. Results indicated that MSPI achieved greater maxillary molar intrusion, reducing anterior face height and altering various craniofacial angles more significantly than Invisalign. MSPI also led to increased SNB° and point-Pog projection. In contrast, Invisalign resulted in greater extrusion of maxillary and mandibular incisors, with some lingual tipping of maxillary

incisors. The type of appliance and initial overbite were significant predictors of final overbite, particularly in males. Both treatments effectively improved overbite, with MSPI working through molar intrusion and mandibular autorotation, while Invisalign achieved results through incisor extrusion.[12]

A retrospective study compared dentitional changes in patients treated with Invisalign versus conventional fixed appliances after extracting four first premolars for bialveolar protrusion. Among 57 patients, the Invisalign group (27 patients) showed significantly increased overbite and interincisal angle, more lingual tipping of maxillary central incisors, distal tipping of maxillary canines, and mesial tipping of maxillary first and second molars compared to the fixed appliance group (30 patients). Conversely, no significant difference was observed in the angular change of mandibular incisors between groups.[13]

3.4. Physiological and microbial effects during clear aligner treatment

The rise in popularity of clear aligners is driven by their inconspicuous appearance and comfortable wear. This surge in usage has prompted investigations into the physiological and microbial effects during treatment. Studies suggest that clear aligners do not notably disrupt the oral microbiome and effectively maintain plaque control, gum health, and reduce white spot lesions. However, the aligner surface may develop features like grooves and microcracks, providing a breeding ground for bacteria and plaque formation. Combining mechanical and chemical cleaning methods proves effective in preventing biofilm buildup and discoloration.[9]

Clear aligners offer orthodontic patients easier and more efficient oral hygiene routines due to their removable nature[3] Maintaining aligner cleanliness requires a systematic approach involving both mechanical and chemical disinfection methods to curb biofilm accumulation[4] While our research suggests potential benefits for oral and periodontal health, further extensive studies, including large-scale prospective trials, are essential to validate these findings comprehensively.[9] A thorough understanding of clear aligners' impact on oral health and the microbiome necessitates research spanning all treatment phases, encompassing early stages through maintenance.

3.5. Clinical performance of various clear aligner brands

Since the introduction of Invisalign™ by Align Technology©, the market for clear aligners has expanded significantly with various brands offering diverse features.[14] These aligners differ in materials, gingival margin design, and methods for controlling tooth movements, such as the use of divots instead of traditional attachments. The inclusion of auxiliaries like elastics and mini-screws has broadened the applicability of aligners to more complex orthodontic cases.[15]

Aligner materials, typically polyurethane or PETG, are crucial for their effectiveness and efficiency. Studies show that the mechanical properties of these materials affect their clinical performance, with factors like color stability, material thickness, and force application being key considerations. Despite a wide commercial presence, scientific literature on alternative brands is limited, with most studies focusing on Invisalign™.[16]

Italy has shown significant scientific interest in alternative brands, with research exploring aligner fitting, material properties, and clinical outcomes. Brands like Airnivol, ALL IN, Arc Angel, Clear Aligner, F22, Nuvola, Smiletech, and Sorridi have been studied for various attributes including thickness, mechanical properties, and effectiveness in different orthodontic movements.[17]

Attachments and auxiliary elements like elastics are critical for aligner efficacy, impacting their ability to perform complex dental movements predictably. The design of the gingival margin also plays a role in aligner retention and fitting. While the literature primarily focuses on Invisalign™, there is growing interest in evaluating the clinical performance of other brands.[18]

4. Conclusion

Clear aligner therapy represents a significant advancement in orthodontic treatment, offering advantages over traditional braces such as improved aesthetics, comfort, and oral hygiene. Studies demonstrate their effectiveness in treating mild to moderate malocclusions with fewer appointments and shorter treatment durations compared to fixed appliances. However, further research is needed to understand their full impact on oral health, especially in complex cases, and to evaluate the clinical performance of alternative aligner brands.

5. Source of Funding

None.

6. Conflict of Interest

None.

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Author biography

Prasad Konda, Professor and HOD

Naailah Faatima, Post Graduate Student

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