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Clear Aligners Vs. Conventional Braces: A Review Of Effectiveness And Limitations

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Abstract:

Orthodontic treatment is crucial for improving dental health and aesthetics, with conventional braces and clear aligners being the most common methods. This review compares these two approaches, highlighting their efficacy, comfort, and aesthetic appeal. Clear aligners, introduced by Kesling in 1946 and popularized by Invisalign® in 1998, offer a discreet, removable option that enhances oral hygiene and reduces discomfort. Studies indicate that while clear aligners are effective for mild to moderate cases, they generally require longer treatment durations compared to conventional braces, which remain the preferred choice for complex malocclusions due to their superior predictability and control. Both treatment methods have advantages and limitations, with the decision often influenced by the patient's lifestyle, aesthetic preferences, and budget. Ultimately, this review underscores the importance of understanding the distinctions between clear aligners and traditional braces to guide patients in making informed choices for their orthodontic care.

Keywords: Orthodontics, Clear Aligners, Conventional Braces, Aesthetics, Treatment Efficacy.

Introduction

Orthodontic treatment is essential for improving dental health, functionality, and aesthetics by addressing misaligned teeth and malocclusions. Over time, advancements in dental technology have introduced various methods to achieve these goals, with conventional metal braces and clear aligners emerging as two of the most widely used treatments. Conventional braces, a well-established approach, use metal

brackets and wires to gradually realign teeth, while clear aligners, such as Invisalign®, provide a more discreet and removable alternative. As patients increasingly seek treatments that offer a balance of effectiveness, comfort, and aesthetics, choosing between these two options has become a critical consideration.[1,2] The concept of clear orthodontic appliances was first introduced by Kesling in 1946, marking the beginning of efforts to develop less conspicuous treatment methods.[3] In 1998, Align Technology, Inc. launched Invisalign®, initially designed for mild crowding and spacing cases. However, with advancements in materials and the computer-assisted design of tooth movement, the range of cases treated with clear aligners has expanded significantly. Numerous studies have reported successful outcomes, showing that modern clear aligners can now address a variety of malocclusions, from mild to severe .[4] Meanwhile, fixed braces have remained the conventional and trusted choice for over a century. Yet, the increasing demand for more aesthetically pleasing and comfortable treatment options has fueled interest in clear aligners. Despite this growing popularity, questions remain about whether clear aligners can serve as a reliable alternative to braces, as treatment decisions often depend on clinicians' experience and limited high-quality evidence.[5] This review aims to provide a comprehensive comparison of conventional braces and clear aligners.

Review of literature

Djeu et al. conducted a retrospective cohort study in the United States, comparing Invisalign® with tip-edge braces among 48 nonextraction patients with similar discrepancy index scores. The study found that Invisalign® treatment took longer, averaging 33.6 months compared to 23.7 months for tip-edge braces.[6] Similarly, Kuncio et al. evaluated nonextraction patients in a retrospective cohort study, noting that Invisalign® required 33.97 months on average, while tip-edge braces took 26.79 months.[7] Grunheid et al. further explored this topic in a retrospective study involving Class I malocclusion patients, revealing similar treatment durations for Invisalign® (25.0 months) and preadjusted edgewise braces (26.3 months).[8] Hennessy et al. conducted a randomized controlled trial in Ireland with nonextraction patients, finding that Invisalign® took 29.1 months, slightly longer than preadjusted edgewise braces, which required 23.7 months.[9] In another retrospective study, Gu et al. compared Invisalign® with straight-wire edgewise braces in nonextraction patients, demonstrating that Invisalign® required 26.0 months compared to 22.1 months for braces.[10] Lanteri et al., through a retrospective cohort study in Italy, found that Invisalign® treatment averaged 28 months, slightly longer than the 25 months required by straight-wire edgewise braces (MBT prescription). [11]Pavoni et al. performed a prospective cohort study in Italy, comparing Invisalign® with self-ligation braces in Class I malocclusion cases with mild crowding, noting treatment durations of 18.33 months for Invisalign® and 15.50 months for braces.[12] Li et al. in China conducted a randomized controlled trial comparing extraction cases, showing that Invisalign® treatment lasted 35.2 months on average, while 3M Unitek braces took 32.2 months. Collectively, these studies indicate that while Invisalign® is a viable alternative to conventional braces, it generally requires a longer treatment duration, though it remains a preferred option for patients seeking a more aesthetic and comfortable orthodontic treatment.[13]

Aesthetic and Comfort Benefits

The primary advantage of clear aligners lies in their aesthetic appeal. Unlike traditional ceramic braces, clear aligners are far less noticeable and less visually intrusive. Additionally, they are removable, which promotes better oral hygiene and reduces the likelihood of periodontal inflammation, compared to fixed braces. Patients also tend to experience less pain and fewer disruptions to their daily routines, making aligner treatment more comfortable overall. A systematic review of the literature confirms that, particularly in the early stages, aligners cause significantly less discomfort than conventional multi-bracket braces.[14] Another key benefit is that aligner therapy requires fewer in-person appointments with the dentist, as the treatment progresses. This differs from fixed appliances, where regular adjustments are necessary. With proper planning and patient cooperation, the frequency of visits can decrease over time.[15]

Treatment Efficacy and Clinical Considerations

Conventional braces offer greater accuracy in tooth movement, boasting a predictability rate exceeding 50%, whereas clear aligners often do not achieve the same level of effectiveness.[16] Research indicates that fixed appliances are more adept at managing complex malocclusions and controlling vertical dimensions. The clinical effectiveness of clear aligner therapy has been explored through various studies, focusing on outcomes, time efficiency, effects on oral health, post-treatment stability, and potential root resorption.[16] Comparative studies, such as those by Djeu et al., reveal that both systems are similarly effective in certain areas like space closure and marginal ridge alignment; however, aligners fall short in managing anteroposterior discrepancies and achieving optimal occlusal contacts.[6] Kassas et al. noted that while aligners effectively level and align dental arches and correct buccolingual inclinations, they may not provide ideal occlusal contacts.[17] Further evaluations of tooth movement accuracy have shown mixed results in achieving predicted movements. Aligners demonstrate time efficiency benefits in non-extraction cases, leading to shorter overall treatment durations and reduced chair time compared to fixed braces. In contrast, extraction cases may require a longer treatment period with aligners.[18,19] Clear aligners also promote better oral hygiene, resulting in lower plaque levels, reduced gingival inflammation, less bleeding, and shallower pocket depths. Patients using aligners generally exhibit improved oral hygiene and periodontal health when compared to those with fixed appliances.[20] While studies on post-retention stability indicate some relapse in both groups, more research is needed to fully understand the long-term stability of clear aligner outcomes.[21] Concerns regarding root resorption exist in orthodontic treatment; however, aligners are associated with a lower incidence and severity of root resorption compared to fixed braces, although incisors tend to be more susceptible due to their significant movement.[22,23] Clear aligners have shown fewer instances of decalcification and root resorption, making them a safer option for some patients. However, the biomechanical limitations of aligners can lead to less effective treatment outcomes in certain cases.[23]

Difference between Conventional Braces and Clear Aligners

Aspect	Clear Aligners	Conventional Braces
Treatment Effectiveness	• Comparable outcomes to braces for mild–moderate malocclusions (crowding/spacing). • Similar reductions in PAR and ABO-OGS scores. • Less effective for severe malocclusions, extraction cases, complex torque, or skeletal discrepancies without auxiliaries.	• Superior for severe and complex malocclusions. • Better control of bodily movement, torque, and vertical corrections. • More predictable outcomes in extractions and challenging biomechanics.
Treatment Duration & Efficiency	• Shorter treatment for mild–moderate cases (14.5–16.9 months). • Requires fewer appointments and chair time. • Fewer emergency visits.	• Longer treatment on average (16.2–23.4 months). • More in-office visits and emergencies (broken brackets, wire issues).
Patient Compliance	• Success depends on wearing aligners 20–22 hrs/day. • Non-compliance leads to relapse, extensions, or refinements.	• Less compliance-dependent
Biomechanical Limitations	• Limited in extrusion, severe rotations, and root torque control. • Often requires auxiliaries (attachments, elastics, TADs).	• Strong control over all tooth movements including torque, extrusion, and rotations.

Aspect	Clear Aligners	Conventional Braces
Oral Hygiene & Periodontal Health	• Removable → allows brushing/flossing. • Associated with lower plaque, better gingival health, reduced WSLs.	• Fixed → hinders hygiene. • Higher risk of plaque, gingivitis, white spot lesions, enamel demineralization.
Root Resorption	• No significant difference compared to braces. • Excessive forces may still cause resorption.	• Similar risk; force magnitude/duration is key factor.
Aesthetics	• Virtually invisible, high aesthetic acceptability.	• Visible; less aesthetic
Comfort & Pain	• Lower discomfort at placement and during adjustments. • Better tolerated overall.	• Higher discomfort during wire changes/activations.
Quality of Life (OHRQoL)	• Less interference with speech, mastication, and daily functioning. • Greater patient satisfaction.	• More impact on speech, chewing, and oral comfort. • May reduce short-term quality of life.

Discussion

Invisalign® offers significant aesthetic and comfort advantages over traditional braces, as it is virtually invisible, removable, and generally less painful, allowing for better oral hygiene and fewer disruptions to daily life. Its clear aligners are particularly appealing to adults or professionals who prefer a discreet treatment option. However, it typically requires longer treatment durations, especially in more complex cases, compared to traditional braces. Studies have shown that, on average, Invisalign® takes longer to achieve desired results, with treatment times ranging from 26 to 35 months depending on the case, while conventional braces typically complete treatment in 18 to 26 months.[8] While Invisalign® is effective for space closure and alignment in nonextraction cases, it struggles with more complicated tooth movements, such as achieving optimal occlusal contacts and managing vertical dimension changes, making fixed appliances a more reliable choice for severe malocclusions or complex cases. Furthermore, although

Invisalign® promotes better oral health by reducing plaque buildup, gingival inflammation, and root resorption, its biomechanical limitations may result in less precise tooth movements in certain scenarios.[13] For patients with complex treatment needs or those requiring rapid changes, traditional braces may still be the preferred option. Ultimately, Invisalign® is a great choice for patients seeking comfort, aesthetics, and less pain, but it may not always provide the same level of control or efficiency for challenging orthodontic issues, requiring careful patient selection and treatment planning. Clear aligners are generally considered safe for clinical use, although they can have a slight cytotoxic effect. Factors that may increase cytotoxicity include longer curing times, which can elevate the cytotoxic impact of 3D printed aligners, and thermoforming, which can enhance the cytotoxicity of Polyethylene terephthalate glycol (PETG) materials.[19] Additionally, wear and abrasion of aligners can lead to particle release, contributing to mild cytotoxicity. Among different aligner materials, Zendura and Smart Track exhibit mild cytotoxicity, while PETG shows the highest cytotoxicity, particularly after thermoforming. Despite these concerns, the clinical use of clear aligners is still considered safe, though more research on their biocompatibility is encouraged. Manufacturers' guidelines should be followed, as material wear can lead to increased ion release. Studies have shown that Clarity aligners exhibit the least toxicity, with slight toxicity observed across various solution concentrations, while Invisalign and SureSmile show mild toxicity at lower dilutions and moderate toxicity at higher concentrations.[24,25]

Conclusion

While clear aligners offer benefits in terms of aesthetics and comfort, traditional braces are still considered the gold standard for managing complex orthodontic cases due to their greater efficacy and predictability. Both options effectively address orthodontic issues, and the choice between them depends on the patient's lifestyle, aesthetic desires, budget, and the complexity of their dental problems. Although traditional braces excel in more complicated cases, clear aligners are gaining popularity for their convenience, visual appeal, and comfort.

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