

Review Article

Indications, limitations, and outcomes of clear aligners in orthodontic treatment

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ABSTRACT

Clear aligners have gained popularity in orthodontic treatment as a comfortable and aesthetically pleasing alternative to traditional braces. The use of clear aligners has increased due to their advantages, including improved aesthetics, easy removability, and minimal soft tissue irritation. The treatment process involves sequential aligners custom-made for each patient, using computer-aided design and manufacturing technology. Clear aligners employ controlled forces to gradually move teeth into proper alignment. However, clear aligners have limitations, such as the need for patient compliance and their effectiveness in addressing complex malocclusions. Clinical considerations include thorough assessment, regular follow-up visits, and patient education. Treatment outcomes vary depending on the specific malocclusion characteristics. Clear aligners have demonstrated benefits in treating mild malocclusions, spacing issues, and certain types of malocclusion corrections. Treatment duration may be shorter compared to fixed appliances in mild cases. Stability and periodontal health can be influenced by clear aligner therapy, which has effects on plaque levels and gingival inflammation. Root resorption is a concern, but aligners have shown a lower prevalence compared to fixed appliances. Compliance, eruption of permanent teeth, and limitations in visualizing hard and soft tissues are important considerations. Overall, clear aligners offer an aesthetic orthodontic treatment option for a variety of dental abnormalities and mild to moderate orthodontic issues.

Keywords: Orthodontics, Orthodontic treatment, Cosmetic, Clear aligners

INTRODUCTION

The study of orthodontics focuses on the identification, avoidance, and treatment of dental problems like misaligned teeth, misaligned jaws, and problems with the mastication process. Because thermoformed splints are more comfortable and aesthetically pleasing than conventional fixed orthodontic equipment, the use of aligner therapy has increased in recent years. The term "clear aligner therapy" (CAT) covers a broad range of

dental appliances with varying mechanisms of action, building techniques, and suitability for different malocclusion therapies. At the end of the 1990s, the company align technology (Santa Clara, CA, USA) developed the Invisalign® system, and clear aligners first became popular there. Starting in 2001, they spread to Italy and other European nations.¹ Since then, there has been an exponential rise in interest in and adoption of this therapeutic alternative to conventional multibracket orthodontic therapy, taking into account the demands and

aesthetic preferences of orthodontic patients.²⁻⁴ Nearly 20 years later, there are numerous brands of aligners available commercially throughout the world (nearly 20 just in Italy), and their prescriptions, applications, and fundamental characteristics have changed.^{6,7} The materials used to produce the aligners on the market nowadays vary in terms of thickness and construction.

Clear aligners have developed into a key aesthetic alternative in orthodontic treatment as a result of the rising demand for orthodontic treatment among adult patients. While many varieties use clear thermoformed plastic aligners to cover some or all of the teeth, there are other important and substantial distinctions that affect each kind of aligner's capacity to handle a variety of orthodontic issues.⁸ The purpose of this review article is to discuss the benefits, drawbacks, and results of using clear aligners in orthodontics.

LITERATURE RESEARCH

The database used the medical subject headings (MeSH) and a combination of all related titles to do a review article search on May 15, 2023, in the PubMed, Medline, and Cochrane databases as well as the Wiley online library. The reference lists of the previously mentioned studies were used as a starting point for a manual search for publications through Google Scholar in order to avoid missing any different studies. In studies that explored the uses, restrictions, and results of clear aligners in orthodontics, we looked for useful information, date, participant age, language, and publication kind were all free.

DISCUSSION

Most patients can benefit from using clear aligners, which have been indicated to be successful. On the basis of the most recent evaluation, this critical appraisal, however, advises that transparent aligners should only be used in certain situations.

Indications

Treatment options include lateral and/or antero-posterior expansion, minimal interproximal tooth reduction, or extraction of a lower incisor for issues with slightly crowded and misaligned areas (1-5 mm).⁹ Additionally, clear aligners can be used to correct spacing issues (1-5 mm). The overbite can be treated by incisor intrusion and advancement in cases of class II, division 2 malocclusions accompanied by a deep bite. Clear aligners may also be used for the treatment of narrow arches that can be expanded without tilting the teeth. Clear aligners can also be used to address cases of relapse following fixed orthodontic treatment, small rotations, flaring, distalization, and closure of space after the extraction of a lower incisor.⁹

Factors consideration

Success with Invisalign therapy depends heavily on patient compliance. At least 20 hours per day should be spent wearing the aligners.¹⁰ Successful clear aligner therapy necessitates extensive clinical knowledge of various orthodontic techniques, accurate diagnosis and treatment planning, and a solid understanding of biomechanics. In any event, fixed appliances will likely be required to straighten the teeth if they tip more than 5 degrees during space closure. If the tipping is greater than 10 degrees, the dentist should either use full fixed appliances to complete the therapy or add a fixed appliance section to straighten the tipping teeth. Nelson recently listed a number of aligner software benefits that were distilled from a meeting. The set-up can be used for diagnosis and treatment planning, evaluating the need for IPR, expansion, extraction, distalisation, or proclination, as well as verifying that the technician has performed modifications, using a consultation device to show treatment limits to the patient, verifying that the aligner is tracking, evaluating anchorage with the superimposition or surgical simulation tools and staging, addressing the patient's chief concern (anterior tooth alignment) at the beginning of the series, and applying simultaneous movements to reduce the overall number of aligners.¹⁰

Treatment outcomes

Individual malocclusion characteristics and overall combined malocclusion correction can be taken into account when evaluating treatment outcomes. The evidence had a moderate risk of bias when it came to certain malocclusion traits. The anterior crowding is corrected using aligners. In non-extraction circumstances, they are successful in achieving tipping movements.¹¹⁻¹³ According to several studies, aligners are less predictable and effective at controlling physiological tooth movement, especially at extraction sites.¹⁴⁻¹⁸ Aligner therapy appears to achieve efficient (2.25 mm) maxillary molar distalization, without significant molar tipping or extrusion, with minimal impact on vertical skeletal relations.^{18,19} Aligners do not appear to be clinically effective in their rotational correction and demonstrate low predictability of response for canines and premolars (39%), while incisors achieve a better response rate (60%).¹⁸ Strategies that have been suggested to improve the rotational efficiency of aligners include the use of attachments (>15°), interproximal reduction, and reducing the aligner staging to 1.5° per aligner.¹⁴ Aligners do not appear to be clinically effective in achieving maxillary incisor extrusion and should therefore be avoided in anterior open bite correction, where this is deemed to be the treatment mechanic of choice. In contrast, aligners appear to be equally effective at achieving mild degrees of maxillary incisor intrusion as continuous fixed arch mechanics.²⁰ Aligners could be an effective tool for producing arch expansion, being more effective in the premolar region and less effective in the canine and second molar areas. Predictability appears to

be reasonable for expansive movement.²¹ With respect to open bite correction, a recent study compared fixed appliances and clear aligner therapy in correcting the anterior open bite and controlling the vertical dimension in adult patients with hyper divergent skeletal patterns.²² The authors reported that anterior open bite correction and changes in the mandibular plane angle, associated with the use of clear aligners and fixed appliances, did not demonstrate any statistically significant differences in adult hyperdivergent patients. In terms of overall malocclusion correction, the present evidence base would lead us to recommend that, when compared to fixed appliance therapy, aligners perform equally well in mild, non-extraction cases.¹⁷ However, they should be used with greater care in the treatment of more difficult malocclusions, requiring extraction therapy, due to their reported inherent difficulties in achieving torque control, optimal root approximation, and contact point relations.^{14,16} The evidence base for these recommendations is at low to moderate risk of bias.

Treatment duration

The available evidence would lead us to suggest that in terms of optimal treatment duration for mild malocclusions, treated on a non-extraction basis, aligner therapy results in clinically significant shorter treatment duration (range: 3-6 months) compared to conventional fixed appliance treatment and could be the appliance of choice.⁸ The evidence base for this recommendation is at moderate risk of bias. For more severe malocclusions, particularly those requiring premolar extractions, conventional fixed appliance therapy results in shorter treatment durations and would be the system of choice.¹⁵ The evidence base for this recommendation is at low risk of bias.

Chair-side clinical time

There is moderate quality evidence to suggest that aligner therapy is more clinically time efficient as a result of fewer follow-up appointments, less emergency appointment time (7 min), and less chair-side adjustment time (93.4 min).⁸

Post orthodontic treatment stability of clear aligners

Stability is one of the key topics to go over with clear aligners, as it is with all types of orthodontic treatment.²³ One study used the objective grading system of the American board of orthodontics to analyse the post-retention stability outcomes of cases treated with clear aligners and fixed orthodontic appliances. There were no fixed retainers employed; only detachable thermoplastic retainers were used for retention. Both groups' overall alignment relapsed three years following the retention period, although the maxillary anterior levelling in the fixed appliance group seemed stable whereas it relapsed in the Invisalign group.²³

Limitations for the study can be as follows-

Effects of clear aligners on periodontal status and oral health

As more individuals started utilising transparent aligners, the research found that this treatment had detrimental periodontal effects.^{24,25} The use of clear aligners also enhances periodontal health by decreasing plaque levels, gingival inflammation, bleeding upon probing, and pocket depth.^{24,26} Fixed equipment and wires make it difficult to control plaque and have harmful effects on periodontal tissues, making orthodontic therapy a risk factor for periodontal diseases.²⁷ However, Han et al study discovered that with careful oral hygiene education and consistent plaque management, patients treated with fixed equipment and transparent aligners both demonstrated equivalent gingival and plaque indices.²⁴

Root resorption and clear aligners

One of the main issues with orthodontic treatment is root resorption, which is known to be exacerbated by fixed appliances by applying too much pressure at the apical level, which can lead to external apical root resorption.^{28,29} Nevertheless, only a few studies have examined the impact of thermoplastic aligners on root resorption. Aligners may potentially result in root resorption at the conclusion of orthodontic therapy, according to a thorough analysis from 2017 that could only include three studies.³⁰ The prevalence and severity are lessened, nonetheless, when compared to stationary equipment. According to a different study.⁶ The frequency of root resorption brought on by aligners is comparable to that brought on by mild orthodontic pressure. This situation is explained by the root structure and the great extent of movement shown by the incisors.³⁰ The fact that existing clinical studies are based on data obtained from various time periods and thus combine treatments carried out in accordance with various aligner protocols or are based on outdated protocols may be a potential limitation of the current investigation. Compliance is the most important.¹⁰ The orthodontist must depend on the patient's drive and reliability to get the desired outcomes because the aligners are not fixed. Prior to employing this appliance for treatment, all permanent teeth must be fully erupted. Basal orthopaedic change cannot yet be incorporated through this appliance system. Major restorative work should be finished before treatment begins since it is impossible to change the surface architecture of the teeth during therapy because doing so will affect how well the aligners fit. Lastly, it is not possible for the dentist to accurately determine how the teeth relate to the basal bone, the lips, or other soft tissues of the head using Invisalign scanning, as it is unable to visualize the hard and soft tissues of the skull.

CONCLUSION

For many people who desire to straighten their teeth and enhance their bite, clear aligners are a common and popular orthodontic treatment choice. They can straighten teeth without the agony and inconvenience of conventional braces because they are practically undetectable and detachable. A variety of dental abnormalities, such as crowding, spacing, over- or underbite, cross-bite, open bite, and mild to moderate orthodontic issues, can be treated using clear aligners.

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