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## Aligners in orthodontics: A review

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### Abstract

As the demand for esthetic treatments is increasing, more people are seeking alternatives to fixed orthodontic appliances. Clear aligners are an esthetic and comfortable option for orthodontic treatment and have gained immense popularity over the last decade. This review will highlight the increasing popularity of clear aligners by describing some aligner systems frequently used today. Most of the patients seeking orthodontic treatment these days are motivated by esthetic considerations. The majority of these patients rejects wearing conventional orthodontic appliances and has a strong preference towards more esthetic treatment options, including lingual orthodontics and esthetic thermoformed appliances. The Align technology introduced the invisalign appliance in 1999, since then the Invisalign appliance and similar kinds have gained tremendous attention from adult patients and dental professionals. The thermoformed esthetic appliances (invisible retainers and clear aligners) are gaining an increasing interest as an alternative treatment option in adult patient in multidisciplinary complex cases to simplify the treatment plan.

**Keywords:** esthetics, aligners, retainers

### Introduction

Esthetic concerns are often a significant factor for most patients, many of whom are unwilling to wear braces, because they do not want the look of fixed appliances. This has produced a demand for more aesthetic appliances. In a study conducted by Nedwed *et al.* of 54 patients, it was found that the majority of patients who undergo this treatment are females (78%) and this is probably related to the greater attention to the aesthetic aspect [9].

The esthetic thermoformed appliances represent an option in the treatment of simple malocclusions but have some limitations; in However, the expense in production, dependency on patient cooperation, and the inability to treat certain malocclusions limit the usage of clear aligners [1, 3, 5] fact, achieving similar results to those obtained with conventional fixed orthodontic appliances can be difficult. Nevertheless, such devices show excellent aesthetic during treatment phases, ease of use, is comfortable to wear and show superior oral hygiene. Despite growing popularity and its use even in complex cases [2, 3], questions still remains concerning the proper use of this technique and its limitations due to the characteristics of the material and the thermoforming process, which in specific cases can limit or even make the use of clear aligners very difficult. The purpose of this article is to discuss some of the key benefits and some limitations, inconveniences and potential hazards associated with invisible retainers and clear aligner therapy

### Invisible retainers: (Figure 1)

The most esthetic and versatile of all retainers used in orthodontic practice is the invisible retainer. This type of thin acrylic retainer was developed originally by Robert Ponitz of Ann Arbor, Michigan. Typically this retainer is formed from a sheet of thin biocryl or other similar material that is heated and forced by suction or pressure [4, 5] on to a working model of the dentition.

The invisible retainer has the two typical applications: minor tooth movement and long-term retention.

### Minor tooth movement

Invisible retainers can produce minor tooth movements effectively, especially the correction of minor relapse during the retention period. The elasticity of the acrylic used in the fabrication of the invisible retainer can help force the relapsed tooth into a new, aligned position. The amount of tooth movement possible with a traditional invisible retainer, however, is limited. Routinely only one tooth per quadrant can be moved effectively. If a patient has significant relapse following treatment, the use of invisible retainers is contraindicated.

### Long-term retention

The second function of the invisible retainer is to stabilize the dentition following orthodontic treatment as a long-term retention appliance. These acrylic retainers usually will last for six to twelve months or longer, depending on the usage pattern of the patient. Some patients use these retainers indefinitely, whereas patients with parafunctional habits show a high degree of wear and/or breakage. In the latter case the invisible retainer is contraindicated.

### The clear aligner therapy: (Figure 2)

The first clear aligner system Invisalign system was introduced at an orthodontic meeting in 1999 and first described in a peer-reviewed publication in 2000 [6]. It is an esthetic orthodontic treatment alternative developed by aligns technology, for patients who want to improve their tooth alignment, but do not want treatment with conventional braces. The system was introduced in the late 1990s and uses computer-aided design and computer-aided manufacturing (CAD/CAM) technology to fabricate a series of custom appliances in polyurethane that are esthetic (transparent), removable and thin (less than 1 mm). The whole process of realization of the Invisalign aligners is a marvel of modern technology.

### How does it work?

For each patient, the orthodontist submits a set of polyvinyl siloxane impressions, a centric occlusion bite registration, a panoramic radiograph, a lateral cephalometric radiograph, and photographs to clear aligner lab. At this point, the system scans the plaster models, develops a 3D presentation, separates the teeth (allowing them to be moved individually) and places them in their virtual aligned position, thus simulating the results.

Tooth movements are staged in order to avoid interproximal and occlusal interferences, the number of stages required is related to the amount and complexity of the necessary movement. The aligners are capable of producing tooth movement (in increments of about 0.25-0.3 mm) in a period of two weeks from beginning to end of treatment. These data are then sent to the orthodontist, who evaluates it himself and then displays to the patient the virtual treatment of the final position of the teeth given by the system. When the orthodontist has approved the proposed treatment plan, the series of aligners will be manufactured. Each aligner is laser-engraved with the patient's initials, case number, aligner number and arch (upper and lower). They are then disinfected, packaged and shipped to the orthodontist. If the results are unsatisfactory, clinician may use auxiliary appliances (fixed braces) or request new aligners. The orthodontist plays a limited role during treatment with the clear aligners.

### Compliance

Since these devices are removable, patient motivation is important to achieve the desired results to be effective, in fact, these devices must be worn 22 hours a day (must be removed during meals, when drinking hot drinks that could spot or cause deformation, sugary drinks and during the oral hygiene maintenance at home).

### Indications

Joffe [10] suggested that the clear aligners are most successful in following cases:

- Treating mild malocclusions (1 to 5 mm of crowding or spacing).
- Deep overbite problems (e.g., class II division 2 malocclusions) when the overbite can be reduced by intrusion or advancement of incisors.
- Non-skeletal constricted arches that can be expanded with limited tipping of the teeth.
- Mild relapse after fixed-appliance therapy.

### Contraindications

Conditions [11] that can be difficult to treat with an invisalign appliance or are contra-indicated altogether include:

- Skeletal anterior-posterior discrepancies of more than 2 mm (as measured by discrepancies in cuspid relationships).
- Centric-relation and centric-occlusion discrepancies.
- Severely rotated teeth (more than 20 degrees).
- Open bites (anterior and posterior) that need to be closed.
- Extrusion of teeth and crowding and spacing over 5 mm.
- Severely tipped teeth (more than 45 degrees).
- Teeth with short clinical crowns.
- Arches with multiple missing teeth.

### Disadvantages

- The clear aligners, because of their removability, have very limited control over precise tooth movements (root alignment during closure of the extraction spaces, uprighting, significant tooth rotations and tooth extrusions) and can prevent the use of class ii or class iii elastics.
- The delay time between the formulation of a virtual treatment plan and the application of the appliance can sometimes exceed 2 months: this can cause further delay if dental changes are significant, since it will be necessary to reschedule the treatment and wait for the period required to make new aligners.

### Root Resorption and Clear Aligners

Root resorption is one of the chief problems of orthodontic treatment and it is known that fixed orthodontic appliances can give rise to root resorption, generating excessive pressure at the apical level and causing external apical root resorption. However, few studies have assessed root resorption caused by thermoplastic aligners. A systematic review conducted in 2017 that could include only three studies concluded that aligners could also cause root resorption at the end of orthodontic treatment; however, the incidence and severity are lower as compared to fixed appliances [13]. Another study stated that the incidence of root resorption caused by aligners is similar to the resorption caused by light orthodontic forces [14]. According to the study by Gay *et al.*, 41.81% of teeth showed signs of apical root resorption after clear aligner treatment, with upper and lower incisors being the most

affected teeth. This situation is explained by the root structure and the great extent of movement shown by the incisors.



**Fig 1:** Invisible retainers (Essix Retainer)



**Fig 2:** Clear Aligner

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## Conclusions

- Clear aligners provide an esthetic and comfortable option to conventional fixed mechanics.
- Obtaining periodontal health is easier in patients treated with clear aligners and less white spot lesions develop during the treatment.
- Clear aligners can be used in mild to moderate crowding cases but caution must be exercised in complex cases.
- Root resorption is still a risk associated with orthodontic treatment in aligner therapy, such as in fixed appliances.
- Long term stability studies are required in this field.

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