



## **ORTHODONTIC TREATMENT WITH CLEAR ALIGNERS BETWEEN EVOLUTION AND EFFICIENCY: A LITERATURE REVIEW**

Abusafia Bayan<sup>1</sup> and Yang Yan<sup>2\*</sup>

*<sup>1</sup>Resident and Master degree student of Clinical Orthodontics, Department of Stomatology, Zhongnan Hospital, Wuhan, China.*

*<sup>2\*</sup>Professor of Orthodontics, Stomatology Department, Zhongnan Hospital, Wuhan University, Wuhan, China.*

### **ABSTRACT**

In recent years, the number of patients seeking orthodontic treatment alternatives is increasing. Such treatment alternatives (Clear aligners) meet the needs of the patients in regard of the esthetic demand and comfortable option for the orthodontic treatment since the Clear Aligners system is more tolerable and more esthetic than ceramic or metal brackets. This alternative system increases the patients' satisfaction and also obtains better clinical outcomes. As the demand for esthetic treatment is growing, it has gained enormous popularity all over the world. As well, technological developments and enhancements are also weighty in this field to develop the system. This review study highlights the Clear Aligners in light of the following: its advantages, its disadvantages, its scope and limitations, its clinical effectiveness, and its efficacy. Outcomes attained with this technique will be discussed. The main purpose of this study review is to demonstrate the evolution of Clear Aligners at all levels. Clear Aligners system are linked with less adverse actions and compact gingival inflammation and plaque formation. Earlier studies have verified that the outcomes an effectiveness are similar when patients with conventional fixed appliances. However, better clinical outcomes are expected with this modality, the Clear Aligners.

## INTRODUCTION

Clear aligners started 20 years ago in America as a manual modification of a study cast and a vacuum retainer was made on the modified cast to correct a relapsed single tooth. After those multiple researches were made on the aligners, it was capable to treat about 20% of orthodontic cases. It is worth noting that the aligners appeared for the first time at the end of the 1990s by the company Align Technology® (Santa Clara, CA, USA), which then gave life to the Invisalign® system, and then they were distributed to all over the world.<sup>1,2</sup>

Since then, all those concerned in the field of orthodontic -including orthodontist, patients and patients- have showed much interest in Clear Aligners when compare to classic Fixed orthodontic therapy, and that resulted to greater growth and increase for Clear Aligners. This is due to the needs and aesthetic demand of orthodontic patients.<sup>3</sup> Consequently, the rise in the number of orthodontic patients has prompted an increase in the demand for esthetic and comfortable alternatives to conventional fixed appliances.<sup>4-6</sup> Clear aligners that meet the needs this demand are also prone to rapid technological perfections in Clear Aligner materials and production techniques .<sup>4</sup> the commercial proposals regarding aligners include many different brands all over the world, and their indications, applications and constitutive features have evolved .<sup>7,8</sup>

The gingival margin design, the thermoplastic materials used, and the dissimilar strategies used to director orthodontic movement such as attachments, divots and auxiliary tools converge in determining the effectiveness of a system of clear aligners.<sup>9</sup>

Clear Aligners have one function but in regard of the brands they are various and different. This is because there is not a “single unified system” for Clear Aligners; there are “numerous different systems” .<sup>4,10</sup> Their indication was initially limited to the leveling and alignment of the arches with insignificant crowding or diastemas .<sup>11</sup> By now, clear aligners are capable of treatment a large part of orthodontic cases including complex cases and moving multiple teeth. It is worth mentioning that Clear Aligners now can perform bodily movements of the teeth.

Whole resolution of a case in which aesthetic needs can also be associated with functional ones can be often positively treated with the “hybrid” therapies, where clear aligners’ action is joined to auxiliary tools (mini-screws, elastics, sectional wires, rapid palatal expanders, and so on ).<sup>11-15</sup>

The quality of the orthodontic digital system contributed to extend other specialized fields.<sup>16,17</sup> Int. J. made it possible to better evaluate the fit of the aligners and their overall design for better case management.<sup>18,19</sup>

Before starting the treatment, dentists can show their patients video demonstration to convince them of clean aligners. This is a very effective and helpful method to let patients see the final predictable result of the orthodontic treatment the dentist is going to do for them.

### **Advantages, disadvantages and Digital Software:**

#### **Advantages of Clear Aligners:**

Many advantages and Some disadvantages were reported with using Clear Aligners among studies in the literature as compared to the fixed multibracket orthodontic therapy (Figure 1).

Among the reported advantages, studies demonstrated that clear aligners are clear so it provides maximum esthetics, and nowadays most patients focus more on the esthetic side. Clear Aligners eradicate the labial fixed appliances appearance. Accordingly, estimates show that the Clear aligners compounds are the most widely chosen and accepted modalities among people suffering from speech and esthetic problems that are usually associated with the conventional fixed appliances. In addition, there is another important reason why patients prefer Clear Aligners that is related to the psychological side effects. Patients won't hesitate when smiling simply because Clear Aligners will give them confidence and trust.

It was previously reported that clear aligners are usually comfortable for patients as the appliance can be removed which gives an adequate chance for the periodontal ligament to heal during drinking, eating, and cleaning of the appliance and allow normal brushing and flossing teeth.<sup>20</sup>

Additionally, Clear Aligners result less pain when compared to that of fixed conventional appliances because we can control the amount of movement through digital software system. This was indicated in a survey-based investigation by Nedwed and Miethke that included 54 patients with Invisalign braces to investigate some parameters related to the effectiveness of the appliance as development and duration of pain, adaptation time, symptoms related to the temporomandibular joint, the presence of mucosal and lingual irritation, impairment of speech, and patients' satisfaction and reporting of the relevant information since the modality was installed.<sup>21</sup>

The researchers testified valuable results for the Clear Aligners. Patients witnessed the effectiveness of the system, and that contributed to high level of acceptance and massive popularity for it all over the world. The adaptation period for Invisalign patients has been assessed to be only one week and most patients stated they were satisfied about it. Mild pain for 2-3 days or minimal mucosal irritations might also be experienced.<sup>18</sup> Clear Aligners are very safe for the mouth environment as no emergency situations happen like irritation to the lips, sharp wire injuries and fallen brackets; in the last case (fallen brackets) patient needs to revisit the clinic and that leads to delay the treatment period. Another benefit of the Clear Aligners is that it contributes to less chance of allergy of metal components which we use in fixed conventional appliances.<sup>22</sup>

Before starting the treatment, dentists can show their patients video demonstration to convince them of clear aligners. This is a very effective and helpful method to let patients see the final predictable result of the orthodontic treatment the dentist is going to do for them.

Clear Aligners help to prevent white spots to appear or demineralization during the treatment period. This happens because it is removable, so the patient has an adequate time to clean their teeth when it is removed. Also, dentists can get rid of bonding brackets that is used in conventional appliances because it cause demineralization.

Aligners can be used as a container for home bleaching during the treatment. This happens when the tray is filled with a bleaching material and the patient wears it. Hence, this saves time as the treatment and the bleaching occurs simultaneously.

As a final advantage of the Clear Aligners is that the last aligner can be used as retainer so it eliminates extra costs on the patient.

When it comes to the disadvantages of Clear Aligners, we will find them limited and less than the advantages. The first weakness is that the Clear Aligners depend on the patient's compliance. The more the patient wears it, the better results we get. The less the patient wears it, the worse results we get; i.e., the patient shall wear the appliance as much as he can all day, but he can remove it when needed like eating and cleaning. Whereas in the fixed conventional appliance it is mandatory to be placed all the time.<sup>21</sup> Another weakness point is that there is a strong possibility of losing the aligner when the patient removes it and forgets where the patient puts it because it is clear and transparent so that it is hard to find.

In addition, there are some attachments that are sometimes needed. So, the patient might refuse to use the attachments because he thinks they negatively affect the aesthetic side. Another point that can be considered disadvantages is that the Clear Aligners takes longer time to deliver for the patient. On contrast, we can place the brackets of the fixed conventional appliance on the same day after we finish the treatment plan. the Clear Aligners need retainer after the treatment, this might be an advantage for some and disadvantage for others because we originally need a retainer in both orthodontic treatments the clear aligners therapy and the fixed conventional appliance. Some specialists might consider that Clear Aligners are expensive when compared to braces. However, patients are willing to pay more for the Clear Aligners for the sake of their comfort and well-being. One of the main prominent disadvantages of the Clear Aligners are that the teeth must be fully erupted. This is the most difficult problem dentists may face, and they seek to find a solution for such a problem such as using innovative ways to deal with such cases. Similarly, Clear Aligners can't treat 100% of the cases alone.<sup>22</sup>

Although Clear Aligners have some disadvantages, it does have more important advantages. As Clear Aligners fulfills the desires of patients like aesthetic, comfort and results, this treatment method is worth studying and advancement in order to develop the weakness points to be advantages and benefits.

<b>Advantages of clear aligners:</b>	<b>Disadvantages of clear aligners:</b>
It is clear so it provides maximum esthetics.	Depends on patient's compliance.
Comfortable for patients and no lip irritation.	Possibility of losing the aligner.
Removable so easily cleaned.	Attachments are sometimes needed.
Allows normal brushing and flossing.	Takes longer time to deliver.
Minimal pain compared to that of braces because we control the amount of movement through the software.	Still needs retainer after the treatment.
No emergency situations (sharp wire, fallen brackets, etc.).	Expensive compared to braces.
You can show the patient the predictable results on the software before the beginning of the treatment. No white spots or demineralization during the treatment period.	The teeth must be fully erupted.
Aligners can be used as a tray for home bleaching during the treatment.	Can't treat 100% of the cases alone.
Less chance of allergy (Ni, latex, etc.).	
Last aligner can be used as retainer, so eliminates extra costs on the patient.	

**Figure 1:** Advantages and disadvantages of Invisalign. 5

**Records needed:**

When it comes to records needed of Clear Aligners, we don't need to add new steps. In fact, we need to use the same steps and sometimes less steps, including Radiographs (Panorama, lateral cephalometric), Photographs (intraoral and extra oral) and Study casts (using Rubber base impression material or scanning).

**Properties of the software:**

The Clear Aligners are very unique. It mainly depends on the software system, and that gives very accurate results and details. Adding the software system for the treatment methods of orthodontic allows estimation of each tooth movement. Also, it estimates the space occupied by overlapped teeth and their shape after proper alignment so it eliminates the need of another impression. Moreover, it enables to move the tooth within its biological width. Finally, it predicts the final results so it eliminates the need of wax-setup.<sup>23</sup>

**Scope and Limits of Treatment with Clear Aligners:**

Though the number and difficulty of cases treated with clear aligners continue to rise, it is hard to treat 100% the cases of malocclusions alone with the clear aligners system. Clear aligners are convenient in mild to moderate crowding, closure anterior bite, intrusion, posterior expansion, diastema, lower incisor extraction cases, and molar distalization technique.

There are some cases that are more struggling to accomplish with Clear Aligners, such as: severe rotations correction, movements like extrusion, closure of extraction spaces and molar uprighting. However,

incisor extrusion, molar transition, and closure of extraction spaces are possible with the use of attachments in the Invisalign® system.<sup>23,24</sup>

Up-to-date Researches in this field are still taking place. A lot of scientific researches have proved the development and the success of Clear Aligners.

### **Efficiency and Efficacy of Aligners system:**

As the demand and interest toward the clear aligner system are growing, questions regarding the efficacy of the system remain.<sup>25,26</sup> To date, published data of clinical research on the effectiveness and efficacy of clear aligners isn't satisfying enough as we can do more clinical researches to prove the efficacy and efficiency of Clear Aligners.<sup>27</sup>

### **Clinical Effectiveness of Aligners system:**

In 2021 Al-balaa et al. projected retrospective study to demonstrate that the predicted magnitude of anterior intrusion was compared with the actual clinical outcome. For anterior intrusion (.1 mm), the expected final results of intrusion for patients who were treated with pressure areas without anterior bite plane and another treatment method in posterior extrusion is 51.19%. The study also showed that the maxillary lateral incisors gave a very high level of percentage of tooth movement (58.12%). On the other hand, the lowest tooth movement level percentage was detected with the mandibular incisors (44.71%). As a result, the final result of correction found in this study was 48.81%.<sup>28</sup>

The study recommended that to decrease the rate of midcourse corrections, orthodontists can use some additional methods of anterior teeth intrusion. Therefore, this study proves the effectiveness of Invisalign on anterior intrusion significantly.<sup>28</sup> In the same context, a previous a retrospective study by Kayla Harris et al done to evaluate the dental and skeletal effects that occur in the correction of anterior open bite with clear aligners then the result was open bite closure with clear aligners occurred. Significant retraction of maxillary and mandibular incisors was also observed with treatment. Clear aligners are effective to decrease the vertical dimension in open bite patients.<sup>29</sup>

Anna Auladell et al. conducted a case report (clinical research) to evaluate the efficiency of molar distalization using clear aligners and mini-implants. It aimed at evaluating biomechanics to distalize the lower molars with mini-implant anchorage and clear aligners. The obtained results show that there is a possibility of mandibular molar movement with clear aligners and mini-implants as it is required to get correction of 2 mm or more in the sagittal plane.<sup>30</sup> It's recognized that Clear Aligners are effective in distalizing maxillary molars in non-growing cases without important tipping or extrusion. Hence, clinicians may consider the use of clear aligners in the treatment planning.

Another study done by Li et al. clarifies that the study aimed to examine and compare the prevalence and severity of Apical Root Resorption (ARR) in patients treated with clear aligners and fixed appliances using Cone Beam Computed Tomography (CBCT). The result of the study was the prevalence and severity of ARR measured on CBCT in patients with clear aligners were less than those in patients with fixed appliances.<sup>31</sup>

Djeu et al.<sup>32</sup> conducted the first retrospective cohort study in 2005 to prove the effectiveness of clear aligners, which compared the treatment results of Invisalign® patients with the results of conventional fixed braces using the American Board of Orthodontics grading system. They stated that the two methods have the same effectiveness in space closure, marginal ridge alignment and root paralleling.

Corresponding to the previous study, Kassas et al. stated that the clear aligner system is effective in leveling and aligning arches in mild and moderate cases and in correcting buccolingual inclinations effectively.<sup>33</sup>

Weihong et al. evaluated the effectiveness of the Invisalign system on mild to moderate cases treated with premolar extractions and compared the treatment results obtained with fixed appliances. Their results showed that the two methods can be used in the treatment of extraction cases, and that root angulation got with clear aligners are adequate when we use suitable attachments. Nevertheless, we shall put into our accounts that adequate experience and extensive knowledge are needed for treating extraction cases of the system.<sup>34,35</sup> A great number of the literature studies stresses on the effects attained through the Clear Aligners system.

## CONCLUSION

All those who are concerned in the field of orthodontic -including orthodontists, patients and companies- have showed much interest in Clear Aligners when compared to conventional fixed appliances, and that resulted to greater growth and increase for Clear Aligners all over the world. This is because that the Clear Aligners meet the needs and aesthetic demand of orthodontic patients. It's noting that one of the reasons for clear aligners growing is the increasing patient's demand and this forced companies to produce and market the Clear Aligners, and also forced orthodontists to expand the clinical research about the system. To be successful, this treatment system depends mainly on the patient motivation and compliance as it is critical in achieving the optimal results. Although Clear Aligners have some disadvantages, it does have more important advantages, and on top of them are its clinical effectiveness and efficacy. As Clear Aligners system fulfills the desires of patients like aesthetic, comfort and results, this treatment method is worth studying and advancement in order to develop the weakness points to be advantages and benefits.

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