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## A comparison between two cases were treated with clear aligners versus fixed orthodontic appliances

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### Abstract

Two patients presented with the chief complaint of irregularly placed upper and lower front teeth. Cephalometric analysis for the two patients indicated proclined upper and lower anterior teeth on skeletal class I jaw bases with normal growth pattern. For the first patient the overjet was 2 mm, and the overbite was 3 mm. The maxillary midline had shifted 1 mm to the left from the facial midline and 1 mm to the left from the mandibular midline. Arch perimeter analysis showed 4 mm of tooth material excess in maxillary arch and 6 mm of tooth material excess in lower arch. For the second patient the overjet was 3 mm, and the overbite was 4 mm. The maxillary midline had shifted 1 mm to the left from the facial midline and 1 mm to the left from the mandibular midline. Arch perimeter analysis showed 5 mm of tooth material excess in maxillary arch and 6 mm of tooth material excess in lower arch. Using clear aligners and interproximal enamel reduction (IER) was planned to treat the first patient, while using fixed orthodontic appliance was planned to treat the second patient. Post-treatment results showed a correction of crowded upper and lower incisors, bilateral Class I canine relation was obtained, bilateral Class I molar relation was maintained, and inclination of incisors was improved. The comparison of (treatment period-chair time-chair time in the follow up appointments) between the two patients showed that the average of clear aligners technique was less than in the fixed orthodontic appliance. At the end of treatment, the two patients showed pleased smile with improved smile arc.

**Keywords:** Clear aligner's technique (CAT), interproximal enamel reduction (IER), chair time

### Introduction

Orthodontic treatment is one of the most essential and effective ways to make individual smile in to radiant and more attractive smile.

Influence of appearance in personal and orthodontist lives have led to a considerable interest among the adult population seeking orthodontic treatment in the last few years. Clear aligner's technique (CAT) is the new age of aesthetic orthodontic treatment methods developed especially for adults who are very self-conscious of how they appear.

The frequency of malocclusions in adults is equal to or greater than that observed in children and adolescents<sup>[1, 2]</sup>.

Sometimes patients are hesitant about the pain and discomfort related to braces, as well as metallic smile is unpleasant for young adults who want straighter teeth but refuse traditional metal orthodontics. Clear aligners are utilized to fix crooked teeth, and also close spaces and alter overbites. The treatment includes wearing clear, plastic plate that is custom made for the mouth, making clear aligners a less-recognizable treatment option.

While clear aligners technique is regularly asked for its aesthetic advantages, numerous patients don't realize that it additionally has various oral health advantages<sup>[3, 4]</sup>.

The history of clear aligners is back to 1945, when Dr. H. D. Kesling first proposed a clear, vacuum-formed tooth-positioning appliance for minor tooth movement. It was a labor-intensive process that required manually repositioning teeth reset in wax, and a clear vacuum-formed retainer was made for every tooth movement in a series of stages until the teeth were aligned. This technique was capable of minor tooth alignment. However, the amount of labor required for the task precluded its use on a wide scale, particularly for correction of more complex malocclusions<sup>[5]</sup>.

Another half-century went by until two graduate students at Stanford University in 1997 applied three-dimensional (3D) computer imaging graphics to the field of orthodontics and created the world's first mass-produced, customized clear aligners system.

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This new technology revolutionized the world of dentistry and orthodontics, launching it into the 21st century [6, 7].

In the early days of clear aligners, most clinicians understood them to be an orthodontic appliance that was suitable for the treatment of cases with minor crowding [8]. Today, clear aligners are made of a new triopolymer plastic and make use of optimized attachments. The teeth are moved according to sophisticated computer algorithms developed in the software program, so it is evident that this will be the future of orthodontics [9, 10].

It is important to understand that clear aligner's treatment is a technique, not a product. There is a common misconception that clear aligners are a "compromise" orthodontic appliance that is only capable of minor tooth movement. However, the clear aligners system of today is a comprehensive orthodontic appliance, capable of treating a wide range of malocclusions [11].

**Diagnosis**

First patient was a 22-years-old male patient in the permanent dentition presented with the chief complaint of irregularly placed upper and lower front teeth. The patient had a mild convex profile, and competent lips. The patient had Angle's class I molar relationship. Cephalometric analysis indicated a normal maxilla and mandible with proclined upper and lower anterior teeth on skeletal class I jaw bases with normal growth pattern (ANB =4). The overjet was 2 mm, and the overbite was 3 mm. The maxillary midline had shifted 1 mm to the left from the facial midline and 1 mm to the left from the mandibular midline. Arch perimeter analysis showed 4 mm of tooth material excess in maxillary arch and 6 mm of tooth material excess in lower arch (Fig.1).

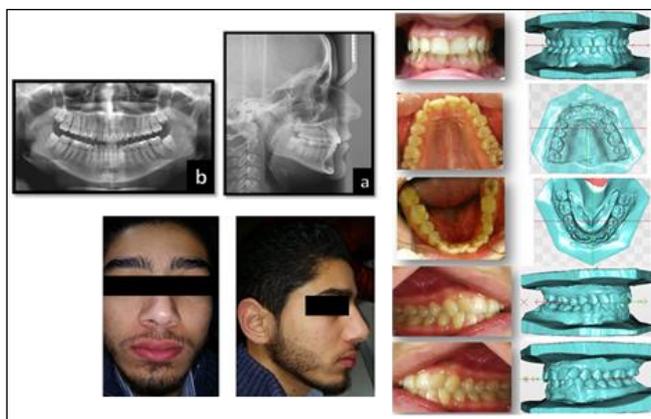


Fig 1: First patient: pre-treatment photographs and radiographs

**Treatment plan and progress**

Therefore we treated for the purpose of improvement of crowding in upper and lower arches, and maintenance of molar relationship. The treatment plan included using clear aligners combined with interproximal enamel reduction (IER).

Twenty two aligners were used for the maxillary and mandibular arches each aligner was applied for 14 days on teeth (22 hours a day).

Interproximal enamel reduction (IER) was applied before applying a new aligner. In total, we have reduced 2 mm from enamel in the upper arch and 3 mm in the lower arch divided on (incisors and canines), the enamel reduction amount was 0.16 mm on each proximal surface of upper arch, while it was 0.25 mm on each proximal surface of lower arch.

The remained tooth material excess was solved by correcting

incisors inclination.

A moderate anterior expansion in the upper and lower arches was applied with effective retraction of the maxillary anterior teeth. A selective intrusion of upper incisors and correction of canines' rotations were achieved (Fig. 2).

The all treatment period was 5 months for maxillary and 6 months for mandibular.

Fluorinated toothpaste and rinse were used by the patient throughout the period of orthodontic treatment in order to ensure the re-mineralization of the dental surfaces which subjected to enamel reduction.

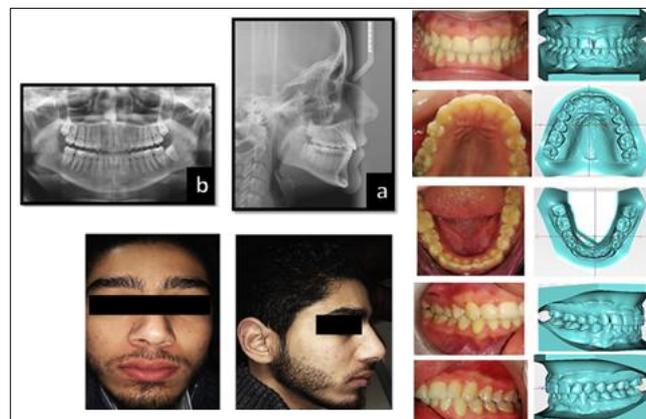


Fig 2: First patient: post-treatment photographs and radiographs

**Diagnosis**

Second patient was a 19-years-old male patient in the permanent dentition presented with the chief complaint of irregularly placed upper and lower front teeth. The patient had a mild convex profile, and competent lips. The patient had Angle's class I molar relationship. Cephalometric analysis indicated a normal maxilla and mandible with proclined upper and lower anterior teeth on skeletal class I jaw bases with normal growth pattern (ANB =4). The overjet was 3 mm, and the overbite was 4 mm. The maxillary midline had shifted 1 mm to the left from the facial midline and 1 mm to the left from the mandibular midline. Arch perimeter analysis showed 5 mm of tooth material excess in maxillary arch and 6 mm of tooth material excess in lower arch (Fig.3).



Fig 3: Second patient: pre-treatment photographs and radiographs

**Treatment plan and progress**

The treatment plan included using fixed orthodontic appliances combined with interproximal enamel reduction (IER).

Brackets (MBT/0.22) were used and the following orthodontic archwires were applied on the upper and lower jaws:

(0.12 NiTi/0.14 NiTi/0.16 NiTi/0.16\*0.22 NiTi/0.17\*0.25 NiTi 0.19\*0.25 S.S).

Interproximal enamel reduction (IER) was applied before applying a new archwire. In total, we have reduced 3 mm from enamel in the upper arch and 3.5 mm in the lower arch divided on (incisors and canines), the enamel reduction amount was 0.25 mm on each proximal surface of upper arch, while it was 0.3 mm on each proximal surface of lower arch. The remained tooth material excess was solved by correcting incisors inclination.

Effective retraction was applied of the maxillary anterior teeth. A selective intrusion of upper incisors and correction of canines and premolars rotations were achieved (Fig.4). The all treatment period was 10 months for maxillary and 11 months for mandibular. Fluorinated toothpaste and rinse were used by the patient throughout the period of orthodontic treatment in order to ensure the re-mineralization of the dental surfaces which subjected to enamel reduction.

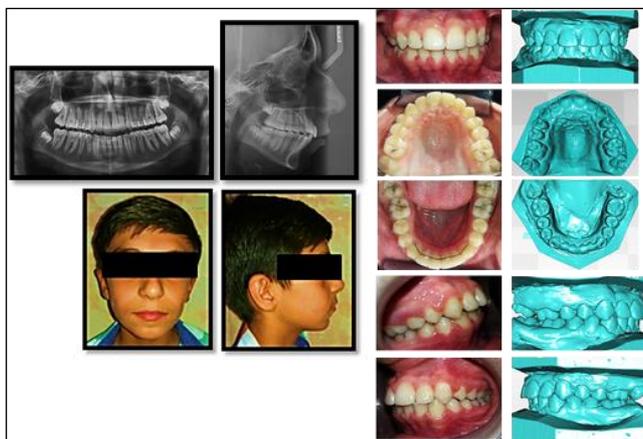


Fig 4: Second patient: post-treatment photographs and radiographs

**Treatment results**

The post-treatment results for the two patients showed excellent improvement in smile. Maxillary and mandibular anterior teeth proclination and crowding were corrected with good buccal occlusion, class I canine relation bilaterally with correction of the overjet and overbite (1, 5 mm for each), and class I molar relation bilaterally maintained throughout the treatment. Post-treatment intraoral photographs and lateral cephalograms showed that the maxillary and mandibular incisors were inclined appropriately. The panoramic radiographs showed adequate root parallelism in both upper and lower arches (Fig.2) and (Fig.4).

The patients wore aligners for retention over 9 months, and

the results remained stable during maintenance and follow up.

**Statistic results**

**Results of the comparison of (treatment period-chair time-chair time in the follow up appointments) between the two patients**

The study of these three variables showed that the patient which treated with clear aligners technique showed significant statistical differences when compared with the patient which treated with the fixed orthodontic appliance at the P value (p <0.05) and the confidence level  $\alpha =95$ . And the average of first patient was less than in the second patient.

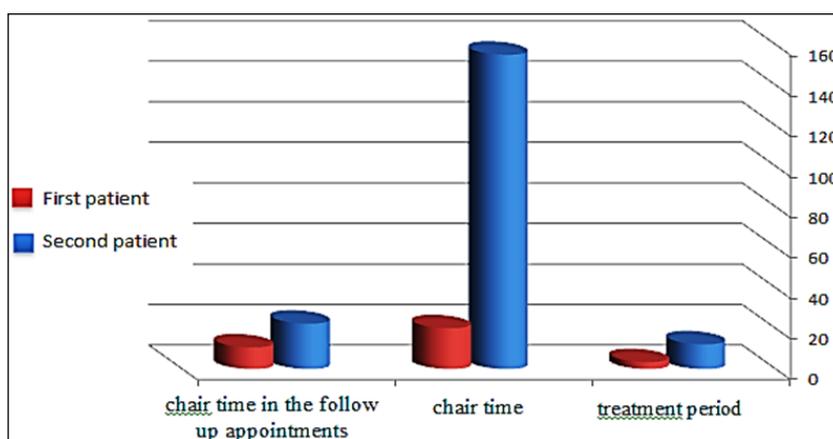
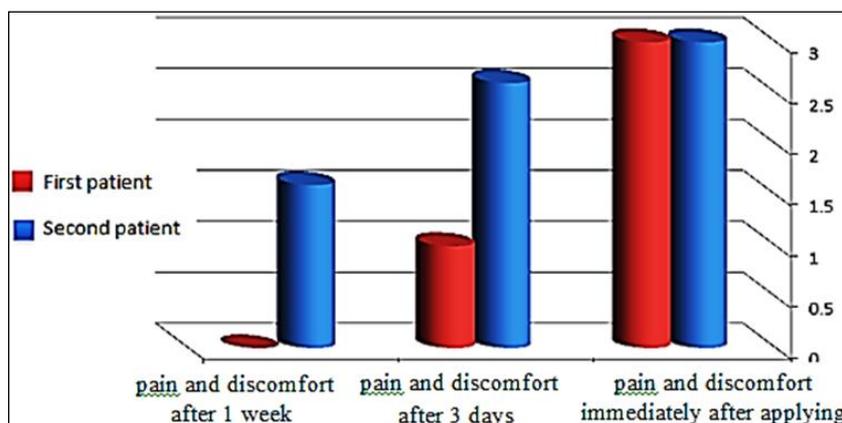


Chart 1: shows the arithmetical averages of (treatment period-chair time-chair time in the follow up appointments) between the two patients

**Results of the comparison of (pain and discomfort immediately after applying the appliances-pain and discomfort after 3 days-pain and discomfort after 1 week) between the two patients**

The study of these variables showed that the patient which treated with clear aligners technique showed significant statistical differences when compared with the patient which

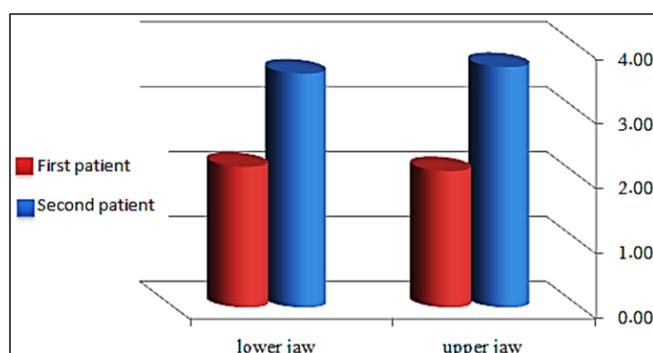
treated with the fixed orthodontic appliance at the P value (p <0.05) and the confidence level  $\alpha =95$ . And the average of first patient was less than in the second patient, except the (pain and discomfort immediately after applying the appliances) variable did not show significant statistical differences.



**Chart 2:** Shows the arithmetical averages of (pain and discomfort immediately after applying the appliances-pain and discomfort after 3 days-pain and discomfort after 1 week) between the two patients

### Results of the comparison of the (Interproximal Enamel Reduction (IER)) on the upper and lower jaws between the two patients

The study of this variables showed that the patient which treated with clear aligners technique showed significant differences when compared with the patient which treated with the fixed orthodontic appliance at the P value ( $p < 0.05$ ) and the confidence level  $\alpha = 95$ . And the average of first patient was less than in the second patient on the upper and lower jaws.



**Chart 3:** shows the arithmetical averages of (Interproximal Enamel Reduction) between the two patients

### Discussion

The main objective of this article was to evaluate the ability to control the movements of upper and lower teeth with two different orthodontic appliances: fixed orthodontic appliances and clear aligners. And to compare the treatment time, pain and discomfort associated with both appliances.

Pain and discomfort are common side effects of orthodontic treatment [12-14]. Pain has a negative effect on patients' compliance [15]. Oral hygiene, and missed appointments [16].

The vast majority of orthodontic patients experience pain during treatment [12]. Pain patterns associated with traditional fixed appliances have been well established [12, 17-19]. Peaking approximately 24 hours after the initiation of treatment, and decreasing thereafter [20].

Since their introduction to the market in 1997, clear aligners have quickly become one of the preferred orthodontic appliances for patients who are concerned with esthetics. It was initially shown that traditional braces were approximately 25% more painful during the first week of treatment than were clear aligners.<sup>21</sup> Recently, Fujiyama *et al.* showed more pain with fixed appliances than with aligners but differences were statistically significant at only some of the time points

[22].

Discomfort of patients treated with fixed orthodontic appliances increased dramatically during the first 24 hours after appliance placement; it peaked after 24-48 hours and then decreased steadily to baseline levels.

Fixed orthodontic appliances produced more discomfort during the first week of treatment than did aligners.

Clear aligners may produce less discomfort because they are removable appliances, which are generally more comfortable than fixed appliances [15, 23]. So they provide intermittent forces, which allow the tissues to reorganize before compressive forces are reapplied [24].

A systematic treatment plan is crucial with the clear aligner's technique. The technique software acts as a valuable tool to assess the need for expansion, extraction, interproximal reduction, distalization or proclination. This mode of treatment requires the clinician to plan out a reasonable sequential tooth movement for every tooth from start to finish. The clear aligner's technique has opened up a contemporary area of adult orthodontics, helping patients who may not want traditional fixed appliances. High quality randomized clinical trials are required to support the claims about clear aligners treatment. However, the key to success is appropriate case selection [22].

So in the first patient a thorough treatment plan was imperative with the clear aligner's technique and a full achievement of the expected treatment goals (Fig. 2) was observed. The orthodontic planning and treatment by these materials and methods together with the patient's good compliance, determined teeth movements that fulfilled the following therapeutic aims: a moderate anterior expansion in the upper and lower arches, appropriate alignment and leveling of the dental arches with effective retraction of the maxillary anterior teeth, a selective intrusion of upper incisors, and correction of canines rotations. Therefore, a Class I relation of the canines was achieved with more appropriate over-jet and over-bite and an enhanced esthetics of the smile. These findings correspond to those obtained by Boyd, Miller and Vlaskalic, who first revealed efficiency of this method as an orthodontic treatment alternative for clinical cases with mild to moderate malocclusions [25, 26, 27].

The patient reported a full adaptation concerning the speech (phonation) already during the first week using the aligners. He described a supportable degree of sensibility ("pressure on the teeth") during the first 24 and 48 hours of a new aligner placement, what clinically corresponds to the sequential "activations" offered by a correction with progressive stages (0.25mm movement for each aligner). The patient also

reported that the aligner esthetic condition is so favorable that it passes unnoticed inside the social context. Besides these advantages, the practicability of use and the clinical conduction of this method should be reinforced, considering the reduced chair time, the predictability and a minor number of interurrences.

Both the commitment to clinical visits and the compliance concerning the use and care of the aligners are fundamental in this treatment approach. The orthodontist should instruct, motivate and make the patients conscious so that they can achieve the expected corrections.

In the second patient a thorough treatment plan was applied with the fixed orthodontic appliance and a full achievement of the expected treatment goals (Fig. 4) was observed. So the following therapeutic aims was obtained: excellent improvement in smile, maxillary and mandibular anterior teeth proclination and crowding were corrected with good buccal occlusion, Class I canine relation bilaterally with correction of the overjet and overbite (1, 5 mm for each), and Class I molar relation bilaterally maintained throughout the treatment. Post-treatment intraoral photographs and lateral cephalogram showed that the maxillary and mandibular incisors were inclined appropriately. The panoramic radiographs showed adequate root parallelism in both upper and lower arches (Fig.4).

All the advantages and/or disadvantages, together with the efficiency of any method for the orthodontic treatment, are based on an accurate and detailed diagnosis and its consequent therapeutic planning. It is the orthodontist task to know and determine the harmony between the treatment goals and each of the properties, effects and limitations of the materials and methods that will be used.

### Conclusions

Considering the treatment goals and outcomes in these two clinical cases which were treated with the clear aligner's technique and fixed orthodontic appliance, we can conclude that:

1. The comparison of (treatment period-chair time-chair time in the follow up appointments) between the clear aligners technique and fixed orthodontic appliance showed that the average of clear aligners technique was less than in the fixed orthodontic appliance.
2. The comparison of (pain and discomfort immediately after applying the appliances-pain and discomfort after 3 days-pain and discomfort after 1 week) between the clear aligners technique and fixed orthodontic appliance showed that the average of clear aligners technique was less than in the fixed orthodontic appliance, except for the (pain and discomfort immediately after applying the appliances) variable did not show significant statistical differences.
3. The comparison of (Interproximal Enamel Reduction (IER) on the upper and lower jaws) between the clear aligner's technique and fixed orthodontic appliance showed that the average of clear aligner's technique was less than in the fixed orthodontic appliance.
4. The comparison between the virtual treatment and the real treatment was highly satisfactory for the clear aligners' patient.
5. Final occlusal scores did not differ between the two systems.

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