DOI: 10.38103/jcmhch.92.15

Case report

CLINICAL USE OF CLEAR ALIGNER IN CLASS I MALOCCLUSION

Dang Ngoc Anh Thu[1], Nguyen Ho Phuong Mai[1], Nguyen Hong Loi[1]
[1]Ondonto - Stomatology center, Hue Central Hospital

ABSTRACT

Orthodontics is one of the increasingly popular dental specialties. With the driving force in technology and the development of materials, nowadays, straightening options is more predictable with clear aligner, it helps to improve the problems of malocclusion more possibly and more comfortably. It is known as a highly aesthetic orthodontic appliance, which is near-invisible, enhances oral hygiene as well as comfort during treatment. Invisalign is one of the pioneers in clear aligners, that's why clear aligners is warmly welcomed all over the world and particularly in Vietnam. In this article, we report two cases of comprehensive treatment with clear aligner from Invisalign within 18 months, under the support of artificial intelligence to plan tooth movement through Clincheck© software. The aim is to present the efficacy of the latest orthodontic therapy, and to offer patients more treatment options in correcting various types of malocclusion.

Keywords: *Clear aligners, Invisalign®, orthodontic treatment, malocclusion.*

I. INTRODUCTION

Orthodontic treatment has become a trend in recent decades to enhance the appearance of the smile and to offer consequence regarding patients' oral health. The effectiveness of orthodontic treatment with fixed appliances has been well-established for many years, associated with the image of the braces system. However, with aesthetic requirements in mind, scientists are always looking for ways to improve materials and force generation methods to meet the increasing demands from patients. The arrival of new and more aesthetically pleasing options in orthodontic treatment, such as lingual braces and clear aligners (CA), offers a more convenient experience for both patients and professionals. Among that, CA therapy has clearly become a potential treatment option for patients, especially adults, who require orthodontic treatment that will not have a detrimental effect on their social and personal lives [1]. In the Vietnamese market, this form is still relatively new with high cost of use.

According to reports, the first tray for the idea of using an elastic and removable tooth positioning appliance in orthodontic treatment was born in 1945 [2]. Personalized by the dentist from the patient's periodic dental impressions. By time, scientists have created many artificial materials with advanced properties to increase the efficiency of tooth movement and reduce the number of visits as well as the time chair.

In 1997, CA were invented by a student named Zia Chishti. This CA was later commercialized by Align company (Align Technology, Inc, Santa Clara, California, USA), under the name Invisalign clear aligner, using software technology developed for treatment diagnosis, simulation and fabrication. With the nature of clear sequential removable thermoplastic appliances [3], when placed CA in the mouth, the orthodontic tray will generate a small amount of optimal force to aid in moving the teeth to a new position. By changing the tray sequentially, the teeth will gradually move towards the desired position. So, CA touch the need of the patient is not only because of its flexible disassembly and high aesthetics, but also the virtual technology that simulates the tooth movement with the support of artificial intelligence (ClinCheck© software - exclusive to Invisalign), it shows the process of

Received: 19/8/2023. **Revised:** 22/9/2023. **Accepted:** 23/9/2023.
Corresponding author: Dang Ngoc Anh Thu. Email: anhthu.dentist@gmail.com. Phone: 0773439014

tooth movement and simulated the final outcome. CA allows for a wide range of treatment options, from class I to class II, III malocclusion, from mild to moderate crowding, tooth spacing, cases with extraction premolar as well as case combined with surgery. Time by time, this appliance is widely indicated and recognized as the most aesthetically effective option for tooth movement. Each company distributing orthodontic trays will have its own data collection system, Invisalign® acquires 3D digitized denture data through a CAD-CAM system by using an intraoral scanner (named iTero), then ClinCheck© use the collected data to analyze and to show a virtual outcome simulation, after that, 3D printing technology with thermoplastic ink was used to print a series of treatment trays [4]. Patients must wear the trays according to the recommended order and time (20-22 hours per day, 10-14 days per tray).

As a role of pioneer with lots of years experience, product of Invisalign® becomes a new and potential dental treatment appliance to meet the needs of patients. This report describes two cases of comprehensive treatment with CA from Invisalign® within 18 months.

II. CASE PRESENTATION

Case 1:

A 26-year-old woman, working as an editor of VTV8 television channel, presented with a Class I malocclusion and maxillary anterior crowding. As her job requires high quality facial aesthetic, she would like to undergo her orthodontic treatment with CA instead of traditional system of fixed appliances (wires, elastic tie and brackets).

Examination: She was in the permanent dentition with class I of first molar, moderate crowding in the maxilla (#5mm), especially upper canines located outside the arch and mild crowding in the mandibular (#2mm), moderate overjet (#3mm) and overbite (#2.7mm) (Figure 2). Her primary concern was the alignment of her maxillary incisors and she refused to fix appliances.

The treatment objectives using Invisalign® were to align her upper anterior incisors and alleviate crowding in both jaws (see treatment outcome simulation in Figure 2.D). The occlusal goals were to maintain class I of molar and obtain class I of canines, keep a normal overbite and overjet and achieve a functional occlusion.

The first treatment with Invisalign® involved 38 upper and 21 lower aligners. Attachments were placed on almost teeth to achieve a more predictable tooth movement using aligners. The patient was instructed to change the aligners every 10 days and to wear the tray for at least 22 hours per day. She was required to have a follow-up examination every 3 months or when it is time to interproximal reduction (IPR) on Teeth, according to the staging of movement. After 9 months, at the time of follow-up examination, the patient was wearing tray number 27, the tray was noted to not fit tightly (off tray) at both upper canines, they have not reached the position predicted by the ClinCheck©. The doctor changed the treatment plan to increase more direction of force on upper canines. The second of Invisalign® treatment presented 18 upper and 8 lower aligners. The patient was required to use elastic from the position of the hook cut on upper canines to the button on lower molar to increase the extrusion force. When the treatment was completed, a bonded lingual fixed retainer was placed on the upper and lower incisors to prevent relapse. For retention, the patient was given a Hawley wrap around for both arch and an Essix retainer. The patient was instructed to use the removable appliances full time for 6 months and nighttime thereafter.

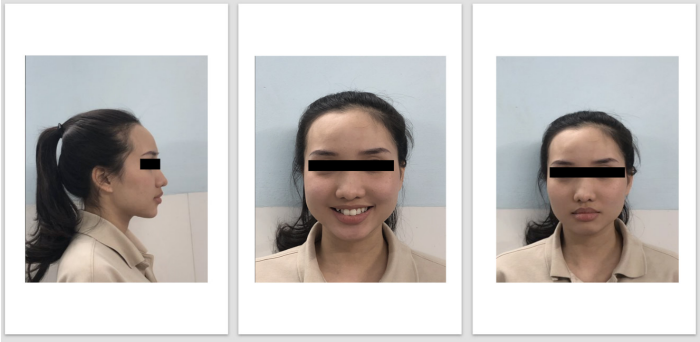

Figure 1: Patient's profile (before treatment) - case 01

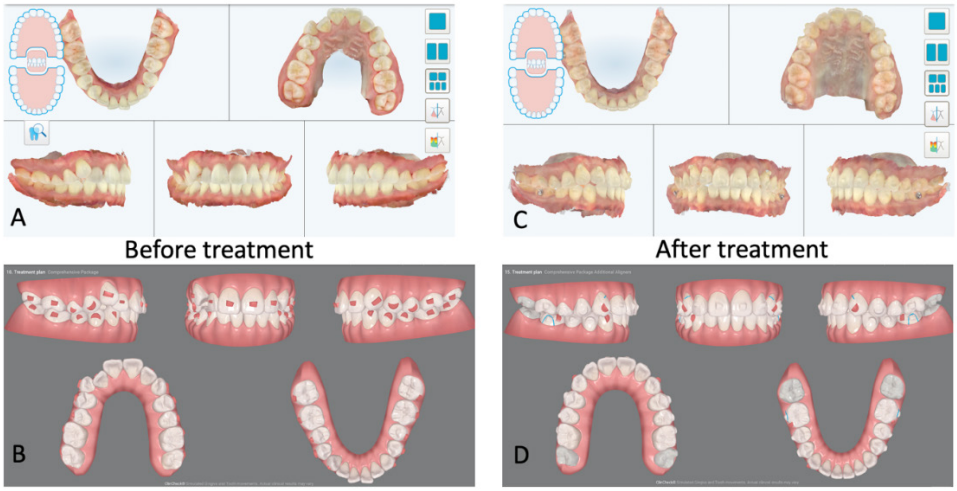

Figure 2: Photo taken by iTero - intraoral scanner (before and after treatment): Images of dental arch and occlusion (A&C), Simulated images recorded by Clincheck© (B&D)

Figure 3: Patient's profile (after treatment) - case 01

Case 2:

A 28-year-old woman, working as a customer care specialist of a life insurance company, presented with a Class I malocclusion and maxillary anterior spacing. Not only the need to communicate with her customers every day was a big problem, but also she had a difficult to schedule her regular dental appointments, so she would like to choose CA for her orthodontic treatment.

Examination: She was in the permanent dentition with class I of first molar and canines, four wisdom teeth are present on the jaw, moderate spacing in the maxillary (#3mm), moderate overjet (#2.5mm) and overbite (#1.8mm). Her primary concern was close all the space in the maxillary, especially maxillary incisors and she deny to use fixed appliances.

The treatment objectives using Invisalign® were to close all the space in the maxillary (see treatment outcome simulation in Figure 4.D). The occlusal goals were to maintain the Class I of molar and canines, keep a normal overbite and overjet and achieve a functional occlusion.

The first treatment with Invisalign® involved 20 upper and 20 lower aligners. Attachments were placed on almost teeth to achieve a more predictable tooth movement using aligners. The patient was required to use elastic from the position of the hook cut on lower canines to the button on upper molar. The patient was instructed to change the aligners every 10 days and to wear the tray for at least 22 hours per day. Patient was required to have a follow-up examination every 3 months or when it is time to interproximal reduction (IPR) on Teeth, according to the staging of movement. After 7 months of initial treatment, a case refinement with 20 more aligners was needed to finish the maxillary arch, and time of changing the aligners is for every 7 days. Once treatment was completed, a bonded lingual fixed retainer was placed on the upper and lower incisors to prevent relapse. For retention, the patient was given a Hawley wrap around for both arch and an Essix retainer. The patient was instructed to use the removable appliances full time for 6 months and nighttime thereafter.

Figure 4: Patient's profile (before treatment) - case 02

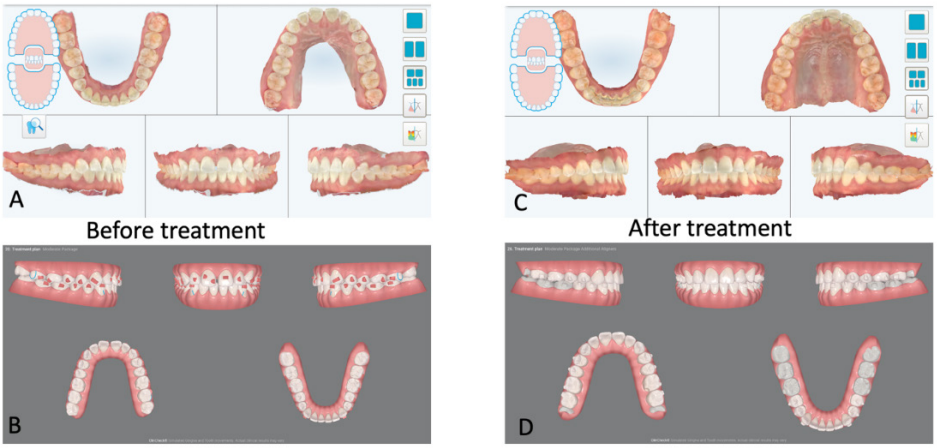

Figure 5: Photo taken by iTero - intraoral scanner (before and after treatment):
Images of dental arch and occlusion (A&C), Simulated images recorded by Clincheck© (B&D)

Figure 6: Patient's profile (after treatment) - case 02

III. DISCUSSION

Some authors have questioned whether the results obtained over the course of treatment with aligners were the same as the AI's simulation in ClinCheck©, however there are currently no studies which are strong enough to answer [5]. But, observations on the treatment results of the two cases in this report show that virtual images are approximately the same as the patient's final occlusion.

The CA has demonstrated results in anterior alignment and good improvement in occlusion, jaw expansion (without surgery), overjet and overbite correction. Also, it can perfectly adjust the midline [6]. CA can be quite effective in reducing deep bites and mild crossbites [4]. With continuous improvement in technique and materials, the benefits of CA are increasing, such as reducing chair's time, increasing the comfort of wearing, easier to clean and more aesthetically pleasing [7, 8].

Compared with conventional removable or fixed appliances, CA combine perfectly with crown anatomy and thus possess the ability of three-dimensional, more controlled movement of the teeth [9]. Furthermore, aligner thickness could provide adequate vertical clearance for cross-bite correction (if present), avoiding use to much additional appliance supporting. CA can also

prevent aesthetic limitations and speech impairment and can allow for optimal oral hygiene. This results in more positive patient feedback and significant improvements in patient's compliance [10]. Additionally, the outstanding of CA compared to traditional orthodontic techniques is being able to view the result virtually before starting the treatment and the clinician can create multiple simulation plans with different treatment outcomes for patients to consider.

In two case reports, patients were positively and pleasantly satisfied with the convenience of using CA, while feeling more secure when receiving treatment with predicted results as well. They also mentioned that daily oral hygiene is a breeze; to clean their teeth, they only use a traditional toothbrush. At the same time, during the treatment process, when examining these two patients, we did not record any new tooth decay or current gingivitis. Indeed, with traditional fixed orthodontic appliances, oral health care is not easy. It requires more time and effort to maintain healthy oral health [11]. On the other hand, the smooth surface of the attachments adheres to the crown during treatment with CA reduces plaque accumulation and makes cleaning easier.

Otherwise, CA has disadvantages such as difficulty in root movement, tooth extrusion, high price, and not being recommended for all types of cases [12]. In our case reports, at the time of follow-up examination at tray no.27 (total 38 trays for upper) of patient no.01, off tray appears in both upper canines, that's mean they have not reached the position predicted by the ClinCheck©. At that time, the extrusion of teeth 13 and 23 was insufficient, and their roots are in unfavorable positions. The clinicians created a new plan to move the teeth, which was consistent with the current maxillary canine position but still did not affect the final simulation treatment results. For the patient no.02, off tray does not occur during the initial treatment period. But the root movement still does not move as planned. Therefore, a series of additional aligner is manufactured to improve the tooth root position. We can easily see that the unfavorable results of CA are inevitable. However, in reality, it is completely possible to overcome these disadvantages thanks to regular examinations to promptly detect unwanted errors. With the skills and knowledge of trained clinicians, it is possible to produce additional aligner to complete the treatment. To ensure effective results, it is necessary to understand the classification of the dentition condition in orthodontic and strictly follow the selection criteria of treatment indication in CA [7].

A study on orthodontic patients showed that both traditional treatment and CA treatment had the same complications of root resorption (with a light force about 25g) [13]. Therefore, although the CA feels gentle during treatment (because of its controlled force on each tray), it is necessary to inform patients about this disadvantage before choosing appliance treatment to avoid false expectations. Furthermore, the risk of relapse is still high after using CA, so retainers should be indicated after treatment.

IV. CONCLUSION

Through 2 cases above, it was noted that CA met the treatment needs of patients, brought comfort during usage and treatment duration is acceptable (less than 18 months). The final result achieve a healthy, functional and esthetic occlusion, combined with a harmonious facial appearance, which will remain relatively stable in the long run.

REFERENCES

1. Fry B. Complex orthodontic treatment using a new protocol for the Invisalign Appliance. Journal of clinical orthodontics: JCO. 2017;51(9):610-4.
2. Kesling HD. The philosophy of the tooth positioning appliance. American Journal of Orthodontics Oral Surgery. 1945;31(6):297-304.
3. Condò R, Mampieri G, Giancotti A, Cerroni L, Divizia A et al. SEM characterization and ageing analysis on two generation of invisible aligners. BMC Oral Health. 2021;21(1):1-11.
4. Boyd RL, Waskalic V. Three-dimensional diagnosis andorthodontic treatment of complex malocclusions with the invisalign appliance. Seminars in orthodontics; 2001: Elsevier.
5. Akdeniz S, Tosun MEA. review of the use of artificial intelligence in orthodontics. Journal of Experimental Clinical Medicine. 2021;38(3s):157-62.
6. Kravitz ND, Kusnoto B, BeGole E, Obrez A, Agran B. How well does Invisalign work? A prospective clinical study evaluating the efficacy of tooth movement with Invisalign.

American Journal of Orthodontics and Dentofacial Orthopedics. 2009;135(1):27-35.

7. Miller KB, McGorray SP, Womack R, Quintero JC, Perelmuter M, Gibson J, et al. A comparison of treatment impacts between Invisalign aligner and fixed appliance therapy during the first week of treatment. American Journal of Orthodontics and Dentofacial Orthopedics. 2007;131(3):302. e1-. e9.
8. Duong T, Eric K. Finishing with invisalign. Progress in orthodontics. 2006;7(1):44-55.
9. Boyd RL. Complex orthodontic treatment using a new protocol for the Invisalign appliance. Journal of clinical orthodontics: JCO. 2007;41(9):525-3.
10. Alajmi S, Shaban A, Al-Azemi R. Comparison of short-term oral impacts experienced by patients treated with Invisalign or conventional fixed orthodontic appliances. Medical Principles and Practice. 2020;29(4):382-8.
11. Beberhold K, Sachse-Kulp A, Schwestka-Poll R, Hornecker E, Ziebolz D. The Orthodontic Plaque Index: an oral hygiene index for patients with multibracket appliances. ORTHODONTICS: The Art and Practice of Dentofacial Enhancement. 2012;13(1):94-9.
12. Melkos AB. Advances in digital technology and orthodontics: a reference to the Invisalign method. Medical Science Monitor. 2005;11(5):PI39-42.
13. Barbagallo LJ, Jones AS, Petocz P, Darendelile MA. Physical properties of root cementum: part 10.Comparison of the effects of invisible removable thermoplastic appliances with light and heavy orthodontic forces on premolar cementum. A microcomputed-tomography study. American Journal of Orthodontics and Dentofacial Orthopedics. 2008;133(2):218-27.