

DISTALIZATION USING EFFICIENT ATTACHMENT PROTOCOL IN CLEAR ALIGNER THERAPY – A CASE REPORT

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Abstract

To describe treatment using aligners in an adult female patient with dental class II malocclusion associated with crowding. Treatment objectives were achieved in 10 months with patient satisfaction. Combining aligners with appropriate attachment location, geometry and staging are efficacious means of resolving class II malocclusion.

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CLASS II CORRECTION BY DISTALIZATION USING CLEAR ALIGNER THERAPY

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Waddah Sabouni: Treatment of the case, supervision and treatment planning of the case.

M. Srirengalakshmi : Writing the case report and revision.

Nikhilesh Vaid: Conceptualization, visualization, supervision and diagnosis of the case.

Samar M. Ade l: Writing the case report, data curation, analysis and interpretation of findings and proofread the final manuscript.

ABSTRACT:

Background: To describe an esthetic orthodontic treatment using aligners in an adult patient with dental class II malocclusion associated with crowding. A 25-year-old female patient with skeletal class I, bilateral class II relation, increased overjet and overbite and crowding in both arches presented for orthodontic treatment. The patient refused conventional fixed multibracket treatment in favor of aligners. Pre- and post-treatment records are presented.

Findings: Treatment objectives were achieved in 10 months, and the patient was satisfied with the functional and esthetic outcomes.

Conclusions: Combining aligners with appropriate attachment location and geometry is an efficacious means of resolving orthodontic issues such as class II malocclusion in a time-frame comparable to that of conventional fixed orthodontics. Staging in distalization increases the predictability of movement. Furthermore, this system is associated with optimal oral hygiene and excellent esthetics.

KEY WORDS: Clear Aligners, Invisalign, Class II, Distalization, Adult Orthodontics, Attachments, Staging.

INTRODUCTION

The global prevalence of Class II malocclusions in permanent dentition is 19.56% [2 - 63%]. Globally, it is considered to be the second most common malocclusion and the most common malocclusion in Caucasian adults.¹ Many treatment options are available for the correction of Class II malocclusion in adult patients including extractions, lower molar protraction and upper molar distalisation.²⁻³

Nowadays, there is an increasing demand for esthetic treatment among both adolescents and adults. The scope of Clear Aligner Therapy (CAT) has improved dramatically over the past decade. Originally directed toward the correction of mild orthodontic problems in adults,⁴⁻⁵ this approach became more challenging when applied to complex anteroposterior discrepancies and orthodontic movements such as posterior intrusion, anterior extrusion and torquing.²

Obviously, successful treatment with clear aligners involves much more than moving teeth virtually by a software.⁶⁻⁷ The application of adjunctive biomechanics through the addition of orthodontic attachments, elastics, and other devices has certainly created more individualized options for more predictable tooth movement across a wider range of malocclusions. Though scholarly literature for treating complex cases is still in its early phase, published case reports have demonstrated satisfying outcomes with complex cases,

such as those involving Class II malocclusions.⁸⁻⁹ Furthermore, the precision of movements has improved exponentially in recent years reaching values of 70% to 80% due to the continuous research performed by Align Technology and the incorporation of attachments and auxiliaries in the treatment protocols.¹⁰

On another note, considering that patients treated with CAT have experienced better quality of life scores and better oral hygiene during treatment, clinicians are driven to proceed further with treatment of challenging cases using CAT.¹¹

To quantify the amount of tooth movement by CAT, 2D lateral cephalograms as well as different digital model registration softwares have been utilized.¹²⁻¹³

This case report describes a case with an effective staging protocol and attachment geometry planning with the Invisalign system in an attempt to correct class II malocclusion in an adult patient.

Case description and results

Case history and diagnosis

A 25-year-old female patient presented for treatment with the chief complaint of forwardly placed upper front teeth. Extraoral clinical examination at rest revealed facial symmetry with equal vertical facial thirds. The smile analysis showed a coincident upper dental midline with the facial midline, a high lip line with increased gum show, as well as a straight smile arc. The patient presented with a mild convex profile with average clinical FMA, a protrusive upper lip with potentially competent lips. Intra-oral examination revealed class II canine and molar relationship bilaterally, increased overjet of approximately 10mm, deep impinging bite, coincident upper and lower dental midlines. The arch forms were V shaped in the upper arch and ovoid in the lower arch. Arch length tooth size analysis showed crowding in upper arch of 2mm and crowding in lower arch of 6 mm. Periodontal biotype and oral hygiene were fair. No signs of parafunctional habits were recorded. Panoramic radiography revealed full dentition, lack of bone defects, no periapical lesions and no temporomandibular joint abnormalities, with the presence of four wisdom teeth. (**Fig. 1**)

Cephalometric analysis (**Table 1**) revealed a Skeletal class I base with average ANB angle and normal facial height with an average growth pattern. Dentally, the upper incisors were forwardly positioned and proclined, while the lower incisors were upright with a decreased interincisal angle. Soft tissue analysis showed acute nasolabial angle with protrusive upper lip. The patient's Angle classification was dental Class II division 1 with upper segments positioned anteriorly.

Treatment objectives and treatment plan

The primary treatment objectives were to achieve class I canines and molar bilaterally and reduce the overjet and overbite. Additional objectives were to relief the crowding in both arches, correct the upper arch form, restore a pleasant smile with optimal lip line and smile arc, achieve lip competency and enhance the patient's profile. It was desirable to reduce the overjet and correct the class II relation by distalising the upper molars and retracting the upper incisors. Since the patient presented with a deep bite, measures to prevent bite deepening were undertaken. The patient had high aesthetic demands and asked for more esthetic alternatives to fixed appliance therapy. A treatment approach with Clear Aligner Therapy was the appliance of choice using Invisalign aligners (Align Technology Inc, Santa Clara, CA, USA). All procedures have been performed in accordance with the ethical standards laid down in an appropriate version of the Declaration of Helsinki.

Treatment progress

The patient was referred to the surgeon to extract wisdom teeth before the start of treatment. The ClinCheck virtual set up dictated 44 steps for each arch (**Fig. 2**). In the upper arch, sequential distalisation was planned to gain space for retraction of incisors, achieving optimal overjet and class I canine and molar relationships bilaterally. Attachments were planned on most of the teeth to guide their movement and control their axes. Vertical attachments were planned for molars and premolars to avoid tipping and aid in bodily movement. The paired vertical root control attachments on the canines bilaterally to help achieve bodily movement and

control their long axes during distalization. Horizontal attachments were planned on upper incisors for extra retention and firmer grip of the aligner.

Class II elastics (3/16inch, heavy force 4.5 oz) were used to augment the movement. The elastics extended from the upper premolars to lower molars. The benefit of using short class II elastics is to prevent any clockwise rotation and bite deepening that might happen due to extrusion of anterior teeth. Intermaxillary elastics were hooked from notches in the upper aligners at first premolar to buttons that were bonded on the lower molars. The lower arch crowding was relieved by the expansion effect of the aligners and the proclination of the lower incisors. The patient was instructed to wear each aligner for 22 h per day and to move on to the next one in the series after 14 days. Mid treatment records are presented in (**Fig. 3**).

Treatment results

Overall treatment time was less than 1 year of active treatment. After 10 months of treatment, the treatment objectives had been successfully fulfilled. The treatment was completed in one phase with no additional refinement required. Forty-four aligners were used as planned by the ClinCheck, where 24 aligners were used for upper molars distalization and the other 20 aligners were used for incisor retraction and finishing. Post treatment records demonstrate satisfactory final results with all objectives achieved (**Fig. 4**). Extraoral photos show an enhanced profile and improved lip competency. The smile of the patient was restored with optimal smile arc and decreased gum show. Intraoral examination reveals coincident upper and lower dental midlines, class I canines and molars bilaterally, adequate overjet and overbite and ovoid well aligned upper and lower arches. Post-treatment panoramic radiography showed good root parallelism, no signs of crestal bone height reduction and no evidence of apical root resorption. Cephalometric and digital model superimpositions highlight the distalisation of upper molars with no vertical movement and retraction of upper incisors. There was a mild extrusion of lower molar and proclination of the lower incisors due to the use of class II elastics which helped reduce the overjet and attain incised contact(**Figs. 5 and 6**). The patient was very satisfied with the treatment results. For retention, the patient had Vivera removable retainers and follow up examination after 1 year of retention showed stable treatment results (**Fig. 7**).

DISCUSSION

The aim of the present case report is to explain the management of a dental class II malocclusion case using CAT, where the patient was not willing to undergo fixed appliance therapy. CAT with intermaxillary elastics enabled resolution of the malocclusion within a treatment time comparable with that required for conventional fixed appliance therapy, providing the patient with comfortable, practical and an esthetically pleasing appliance. There were controversies over whether moderate to difficult malocclusions can be successfully accomplished with CAT.^{5, 7}

The distalization of maxillary molars is frequently the treatment of choice required in class II non extraction patients. Distalization achieved in this case was 2.5mm with no observed vertical movement. These findings are in accordance with the mean reported distalization values by Ravera et al¹⁴ on 20 non growing patients (2.52mm) and Simon et al¹⁵ on 30 adult patients (2.7mm), who reported the highest accuracy for bodily distal movement of molars of 87%. The authors further emphasized the greater accuracy when the movement was supported by the presence of attachments. In the present case, attachments were planned on most teeth to guide their movement and control their axes, resulting in higher predictability of movements. Different attachment angulations and geometries were planned, where vertical attachments were placed on the premolars and molars to prevent tipping and allow for bodily distalization. The attachments were located on the mesial side of the upper molars to prevent any mesial rotation of molars. Additionally, paired vertical root control attachments on the canines bilaterally were placed to help achieve bodily movement and control their long axes during distalization. Horizontal attachments were also planned on upper incisors for extra retention and firmer grip of the aligner. On the contrary, Saif et al³ stated that although distalization can be successfully attained in adult patients with a mean of 2.6mm, significant anchorage loss occurs and the use of attachments has no enhancement effect on distalization. This was further elaborated by a systematic review in 2019 concluding that attachment incorporation is not necessary when molar distalization is planned.¹⁰

Furthermore, Simon et al¹⁵ highlighted the importance of staging in increasing the predictability of distalization. This was also observed in our case, where sequential distalization was planned on 24 stages of aligner treatment, hence achieving the highest predictability of distalization.

The increased overjet was corrected by a combination of upper molars distalization, upper incisor teeth retraction and lower incisor proclination. This was facilitated by the use of class II elastics to augment the anchorage and aid in class II correction. However, short class II intermaxillary elastics were placed from upper premolars to lower molars, unlike the conventional attachment from upper canines to lower molars. The reason behind that protocol was that in this case, it is desirable to avoid the vertical reciprocal forces from elastics to act on the upper anterior teeth, leading to further bite deepening by the clockwise rotation of the upper anterior teeth. In contrast, Patterson et al in 2020 observed on a sample of 80 adult patients, that no significant class II correction or overjet reduction were achieved with class II elastics for an average of 7 months using ABO model grading system.¹⁶

To quantify the amount of tooth movements in the present case, two methods of superimpositions were utilized which were the ClinCheck software superimpositions and the 2D lateral cephalometric superimpositions.

In the present case report, the aligner change was performed every two weeks. Recently, Align Technology has indicated that weekly changes of aligners can be made. A study evaluating the effect of 7 days versus 14 days of aligner wear concluded that the 14 day changes revealed greater accuracy in posterior movements.¹⁷ Moreover, the tooth requires a period of adaptation for recovery to aid in stabilization and increase retention.¹⁸

The whole treatment objectives were accomplished in one phase with no additional refinements in 10 months. This is considered to be a great advantage for CAT where it was proved to result in a significantly shorter treatment duration than with braces.¹⁹ Patterson et al findings contradict our findings where they stated that additional refinements were necessary to address problems created during treatment.¹⁶

CONCLUSIONS

Combined use of aligners with appropriate attachment location and geometry is an efficacious means of resolving more complex orthodontic issues such as class II malocclusions within a time-frame comparable, if not less, to conventional fixed orthodontics, but with excellent esthetics, oral hygiene and quality of life. Proper planning and ideal case selection are essential for achieving the highest predictability of movements. Staging is crucial in molar distalization in CAT.

Consent for publication

Written informed consent was signed by the patient for the inclusion of her images for the purpose of publication.

Availability of supporting data

All data generated or analysed during this study are included in this article in the form of table and figures.

Competing financial and/or non-financial interests

The authors declare that they have no competing interests or other interests that might be perceived to influence the results and/or discussion reported in this paper.

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Table 1: Cephalometric analysis pre and post treatment

PARAMETER	PARAMETER	PRE TREATMENT	POST TREATMENT
SKELETAL	SKELETAL	SKELETAL	SKELETAL

PARAMETER	PARAMETER	PRE TREATMENT	POST TREATMENT
1	SNA	81 ⁰	81 ⁰
2	SNB	79 ⁰	79 ⁰
3	ANB	2 ⁰	2 ⁰
4	WITS APPRAISAL	1.8	1.3
5	FMA	21 ⁰	22 ⁰
6	GONIAL ANGLE	116 ⁰	116 ⁰
7	ODI	74	77
DENTAL	DENTAL	DENTAL	DENTAL
8	U1-NA-LINEAR	9mm	1mm
9	U1-NA- ANGULAR	32 ⁰	12 ⁰
10	L1-NB-LINEAR	2.5mm	5mm
11	L1-NB- ANGULAR	25 ⁰	34 ⁰
12	IIA	124 ⁰	127 ⁰
SOFT TISSUE	SOFT TISSUE	SOFT TISSUE	SOFT TISSUE
13	NLA	106 ⁰	111 ⁰
14	U LIP - E PLANE	-2	-4
15	L LIP - E PLANE	-1	-2

Figure legends:

Figure 1: Pre-treatment records: Extraoral photos, intraoral photos, panoramic radiograph, lateral cephalometric radiograph and tracing.

Figure 2: ClinCheck virtual set up.

Figure 3: Mid treatment intraoral records.

Figure 4 : End of treatment records: Extraoral photos, intraoral photos, panoramic radiograph, lateral cephalometric radiograph.

Figure 5: Superimposition of pre and post lateral cephalometric radiographs: **a:** Overall superimposition on the anterior cranial base, **b:** Superimposition of the maxilla on the anterior contour of the zygomatic process, **c:** Superimposition of the mandible on the symphysis and lower border of the mandible.

Figure 6: Superimposition of pre and post treatment digital models by the ClinCheck.

Figure 7: Intraoral photos after 1 year of retention period.











