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Case Report **Dental Medicine**

Aligner Treatment in Class II Malocclusion Patient by Distalisation with Invisalign: Case Report

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Abstract

Distalization is a common orthodontic technique used to address Class II malocclusions, particularly those where there is an overjet due to maxillary protrusion. It's performed to correct average to moderate class 2 malocclusions (<3mm) by retracting the maxillary teeth. This technique should be preferred in patients presenting a class II malocclusion due to maxillary protrusion or in adult patients undergoing compromise treatment. The following case report describes an adult female patient with class II subdivision in the left side treated by clear aligner (invisalign) by distalization and class II elastics. Sequential distalization protocol was used starting with the second molar, once the second molar has moved two-thirds of the desired distance, the first molar is distalized, followed by the premolars and canines. Finally, the four incisors are retracted to complete the treatment.

Keywords: Distalization, Orthodontics, Class II Malocclusion, Overjet, Maxillary Protrusion, Tooth Movement.

INTRODUCTION

In certain non-extraction cases, maxillary molar distalization is the preferred method to create 2 to 3 mm of space in the dental arch, helping to achieve a Class I relationship in both teenagers and adults. The upper molars can be distalized using either extraoral or intraoral forces [1].

However, these devices like the headgear with the extraoral traction or intraoral appliances with and without skeletal anchorage can produce undesirable tipping of the maxillary molars and/or loss of anterior anchorage during distalization [2, 3].

Achieving bodily tooth movement requires that the applied force pass through the tooth's center of resistance, or alternatively, a complex system of forces and moments must be applied to the tooth crown. A recent review of the available literature evaluated the effectiveness of aligners in aligning and straightening the dental arches, finding better results for mild to moderate crowding compared to those achieved with fixed appliances [4].

More recently, it has been reported that the overall available evidence regarding orthodontic tooth movement control during clear aligner treatment has significantly increased, with three randomized controlled trials classified as grade A and an overall evidence quality rated as moderate to high. It was also noted that maxillary molar distalization (2.5 mm) and the closure of premolar extraction spaces (7 mm) are among the most predictable and controlled movements achievable with clear aligner treatment, in 2014, Simon *et al.*, reported that maxillary molar distalization was the most predictable movement (88%) to achieve using aligners [5].

In this clinical case, a sequential distalization was performed using Invisalign, with the use of orthodontic elastics from the beginning:

OBSERVATION

Diagnosis and Etiology

A 25 years old female patient asked for an aesthetic orthodontic treatment easy to manage, her reason for consultation was the anterior crowding and the gummy smile. No histories of systemic conditions or allergies were reported. Extraoral examination revealed convex profile, straight nose and an elongated labiomental fold. Intraoral examination revealed mild crowding in the upper arch, moderate crowding in the lower arch.

In Occlusion, she had a Class II molar and canine relationship on the right side, class I relationship on the left side. The patient presented with an increased overbite (fig 1).

In the panoramic radiograph, the absence of teeth 18, 28, and 38 is noted, and 48 is impacted. Lateral cephalometric analysis revealed a Class I skeletal pattern (ANB angle of 3°). The maxilla was normal relative to the cranial base with an SNA at 83°. The mandible was normal too with an SNB value of 80°.There was dental protrusion in the lower arch (I/F angle of 106° and IMPA angle of 97°) (fig 2).

Fig. 1: Pretreatment records of the patient. A-C extraoral pictures E-I intraoral pictures

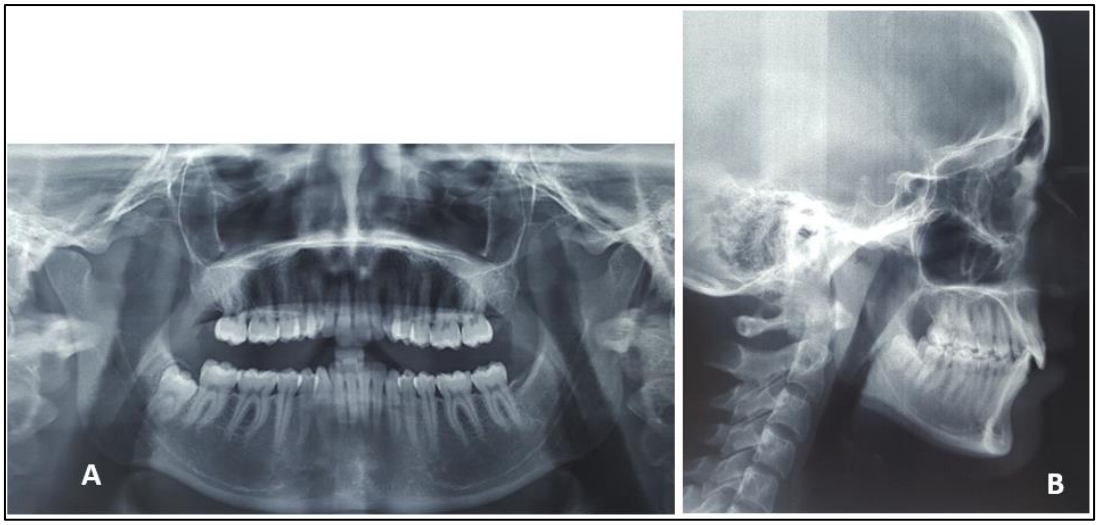


Fig. 2: Pretreatment radiographs. A panoramic x-ray B lateral x-ray

Treatment Plan

Considering the aesthetics request of the patient the treatment plan was designed to obtain a final molar and canine class I relationship through a sequential distalization of the maxillary teeth using invisalign aligners, composite attachments on all the distalizing teeth (fig 3), and class II elastics.

The Treatment Steps

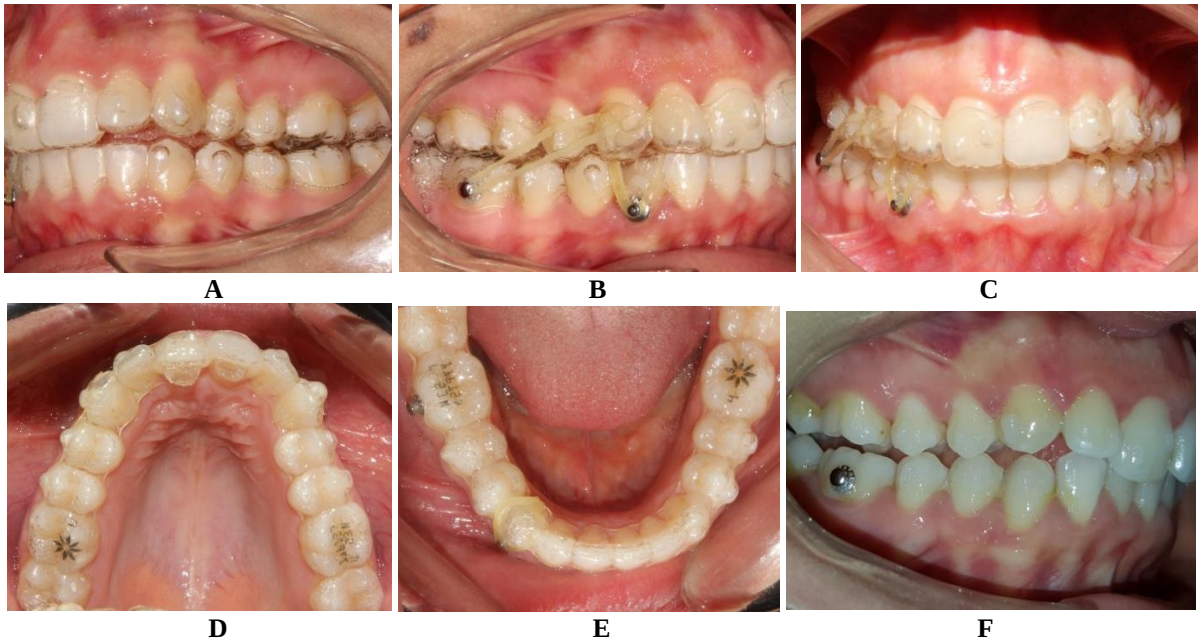
The patient was instructed to wear the aligners and the class II elastics for at least 21 hours per day (fig 4). Aligners were changed every 2 weeks until the maxillary second molar was fully distalized, then every 10 days until the first molar was in the final position, and then every 7 days until the end of treatment (fig 5).

Fig. 3: Place the attachments at the beginning of the treatment. A-E intraoral pictures

Fig. 4: Aligners with class II elastics

Fig. 5: Initial Clin Check. B frontal view A and C sagittal views E and F occlusal views

In an intermediate phase, first outcomes of sequential distalization were clearly visible. As shown in (fig 6), molars already distalized and spaced apart from premolars (fig 7).



A **B** **C**

D **E** **F**

G **H** **I**

J

Fig. 6: First outcomes of sequential distalization. A-F intra oral pictures with aligners and elastics F-J intra oral pictures without aligners

Fig. 7: Creation of space between molars and premolars

The clinical results were excellent, showing final molar and canine Class I relationships with proper overbite and overjet (fig 8).

A **B** **C**

D **E**

Fig. 8: Post treatment pictures. A-E intra oral pictures

The profile of the lower third of the face showed slight improvement compared to the beginning, as the aesthetic analysis and cephalometric measurements already indicated acceptable values at the start of treatment (figs 9, 10, 11).

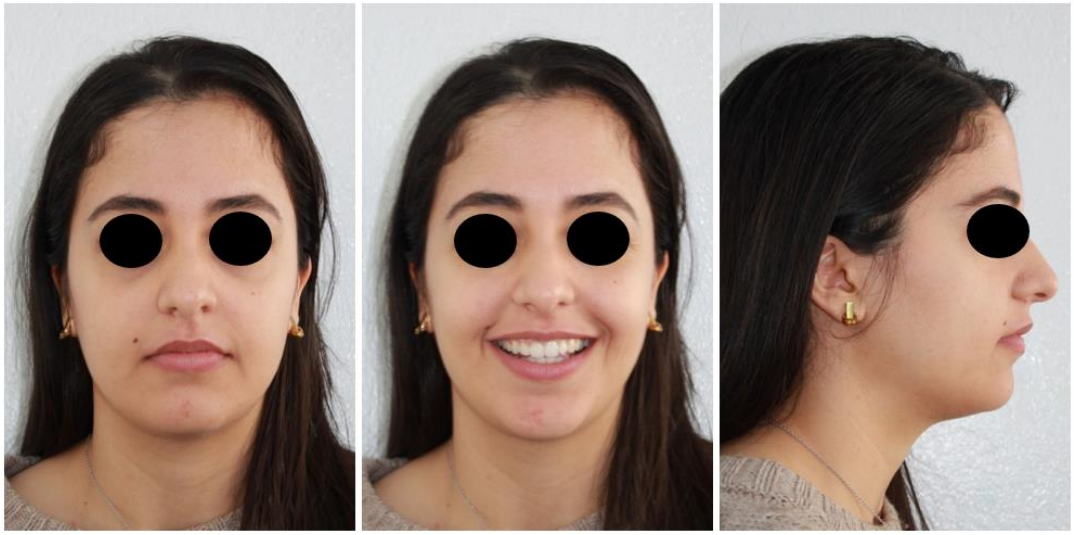
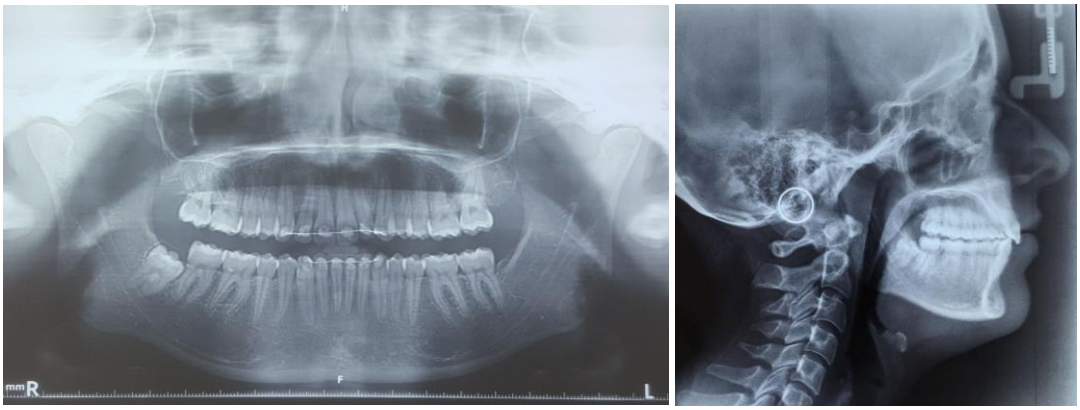


Fig. 9: Post treatment extrabuccal pictures

Fig. 10: Comparison of start and end of treatment. A before treatment B after treatment



A **B**

Fig. 11: Post treatment radiographic records. A post treatment panoramic x-ray B post treatment lateral x-ray

The superimposition of the cephalometric tracings showed maxillary molar distalization with minimal tipping and excellent control over the buccolingual inclination of the incisors (Fig 12).

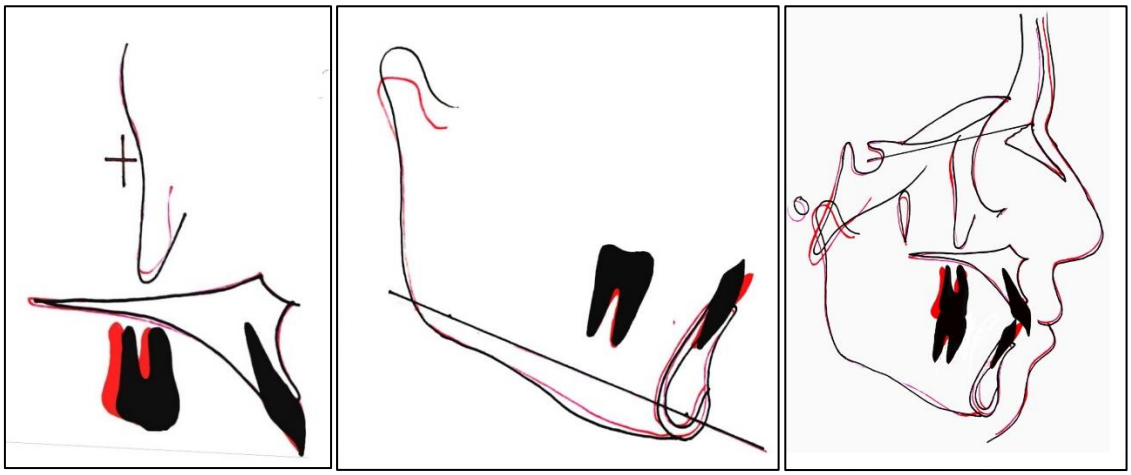


Fig. 12: Superimposition of the cephalometric tracings before and after therapy

DISCUSSION

Sequential distalization is the most commonly used protocol for molar distalization with clear aligner treatment. It involves dividing the dental arch into two segments, with the supporting segment having a greater anchorage mass than the active distalizing segment. This approach makes the movement of posterior teeth, with higher anchorage values, more predictable. In this protocol, aligners are designed to distalize the teeth one at a time, starting with the second molar, which is moved by 0.25 mm per aligner. This is the standard distalization approach in Invisalign treatment, which requires that, once the second molar has moved two-thirds of the desired distance, the first molar is distalized, followed by the premolars and canines. Finally, the four incisors are retracted to complete the treatment. Sequential distalization limits the space opening between teeth, offering a more aesthetic result, and reduces unwanted aligner flexibility by ensuring better contact between the aligners and the teeth. Since distalizing the molar teeth can lead to labial inclination of the anterior teeth, reinforcing the anterior anchorage is essential during the distalization process. Ojima *et al.*, pointed out that sequential distalization results in longer treatment times, which increases the risk of dental caries, periodontal issues, and reduced patient compliance. As a response, some researchers have proposed simultaneous molar distalization, although this approach requires an even greater anterior anchorage [9-18].

While Align Technology suggests that aligners can be changed weekly, a recent study evaluating this claim found that better accuracy in posterior tooth movement was achieved when aligners were worn for 14 days. Most studies on molar distalization recommend wearing aligners for 22 hours a day and changing the aligner trays every 10 to 14 days [19, 20, 13, 9].

Various auxiliaries, such as attachments, elastics, and Temporary Anchorage Devices (TADs), have been used in combination with clear aligners to improve their functionality and effectiveness. Composite attachments, in particular, play a critical role in enabling complex orthodontic movements with clear aligners. Some studies have shown improved anchorage and treatment outcomes when using attachments for molar

distalization, while others report no significant effect. For example, Simon *et al.,* (2014) found greater distalization efficacy in the attachment group compared to the non-attachment group, but the difference was not statistically significant (88.4% for the attachment group vs. 86.9% for the non-attachment group). Garino *et al.*, compared the use of five vertical rectangular attachments per quadrant (from canine to second molar) to three vertical rectangular attachments (on both premolars and the first molar) during sequential distalization with clear aligners. Initially, when the second molar was distalized, no significant difference was found in the amount of movement achieved between the attachment and non-attachment groups. However, when distalizing the first molar, the group without a second molar attachment (the three-attachment group) experienced posterior anchorage loss, resulting in reduced distal movement and tipping of the first molar. This lack of posterior anchorage also compromised anterior tooth control during retraction, leading to incisor tipping. In contrast, the five-attachment group demonstrated more controlled distal bodily movement of both the first molars and the central incisors. Rectangular horizontal attachments are considered the most effective for providing posterior anchorage. On the other hand, placing vertical rectangular attachments on the premolars and molars generates a sufficient moment to counteract tipping and facilitate bodily distalization. Sabouni *et al.,* reported that good control of the long axis was achieved during the distalization of upper canines when paired vertical root control attachments were placed bilaterally. Horizontal attachments were used on the upper incisors to help improve retention and ensure a firm fit for the aligner. When comparing vertical and optimized root control attachments on the upper canines, Comba *et al.*, observed that vertical composite attachments led to buccal displacement, while optimized root control attachments facilitated bodily movement. The use of optimized attachments on the canines in their study resulted in bodily translation without uncontrolled tipping, though some intrusion occurred. This unintended intrusion was significantly reduced when 4 oz Class II elastics were used, enhancing the efficiency of the aligner [21-28, 13, 15, 10].

The elastic effect can be defined as a Class II correction using interarch mechanics. Elastic wear is recommended from the beginning of treatment and should continue until the desired anteroposterior correction is achieved. The effect of elastics is simulated as a one-stage anteroposterior movement at the end of treatment, allowing for verification of final arch coordination and occlusion. Fewer aligners are required when simultaneous staging is used in conjunction with elastics, compared to distalization. However, a preparation phase is necessary, where all potential interarch interferences are removed during the virtual setup planning to create enough space for the Class II elastics to exert their effects. In aligner orthodontics, the use of 6.5mm diameter, 4.5 oz elastics is recommended based on expert clinician experience [6, 7].

Since Class II elastics depend largely on patient compliance, full-time wear is recommended. The average duration for correcting a Class II discrepancy using elastics alone is typically 8.5 months, with the correction primarily involving dentoalveolar effects. This is the average treatment time needed to correct an end-to-end Class II malocclusion, according to the existing literature [8].

The attachment points for elastics can include bonding buttons, brackets, or hooks on specific teeth, precision cuts (precise cuts made on the clear aligners), or the incorporation of a button directly onto the aligner tray. A recent 3D finite element study by Liu *et al.*, examined maxillary molar distalization with clear aligners using different Class II elastic attachment techniques. They observed that, as distalization began, the anterior teeth tended to procline labially, and this tendency worsened as the first molar was distalized. However, when Class II elastics were used during treatment, effective anchorage reinforcement was achieved. The use of Class II elastics with precision cuts provided better anchorage control, with less tooth displacement, and reduced stress on the alveolar bone and periodontal ligament compared to the button technique. Furthermore, precision-cut attachments transmitted anchorage forces directly to the aligner, unlike the common use of canine buttons, which typically apply force to the canines. This results in greater extrusion and rotational tendencies of the canines. Therefore, precision-cut elastics are preferred in cases requiring strong anchorage control without unwanted canine extrusion, such as in hyperdivergent patients. In contrast, for cases with a deep overbite and retroclined incisors, such as Class II Division 2 malocclusion, lower incisor proclination is often the desired movement. In such cases, Class II elastics attached by buttons to the teeth would be more appropriate. Although the studies above highlight the benefits of elastics in clear aligner treatment, a recent study by Taffarel *et al.*, found no statistically significant difference in outcomes between patients who used elastics and those who did not for Class II malocclusion treatment using sequential distalization [29-33].

The use of Temporary anchorage devices (TADs) has increased the scope and predictability of orthodontic treatments. Recently, mini-implants have become widely used in combination with Clear Aligner Therapy (CAT) to facilitate molar distalization. These devices require minimal patient cooperation and have few side effects. A case report published by Greco *et al.*, which treated Class II malocclusion using clear aligner treatment and the incorporation of Temporary Anchorage Devices (TADs), suggested a 100% staging protocol for second molar distalization before inserting TADs. This approach was designed to avoid potential

interference with the roots when the TADs were placed between the first and second molars, simplifying the insertion process. It is believed that the buccal interradicular areas between the maxillary premolars and molars, as well as between the first and second molars, are ideal sites for implant placement. These regions offer primary stability due to their higher cortical bone density. In addition to these buccal interradicular areas, other key implantation sites include the posterior palatal alveolar process, the palatal bone, and the infrazygomatic crest. Mini-implants have been shown to improve vertical control of the posterior teeth while helping to avoid lower anterior labial inclination. However, a study by Ji *et al.,* demonstrated that, regardless of the traction method used with TADs, there is some degree of anterior anchorage loss in the anterior teeth. This suggests a need for increased negative torque to counteract this loss. The study also observed that the height of the TADs in the maxilla plays a significant role in torque control of the anterior teeth, with torque control decreasing as the height of the microimplant increases. A recent finite element study by Jia *et al.,* showed improved anchorage control when elastics were used between mini-screws and the aligners (via lingual buttons, precision cuts, and patient-specific attachments) for maxillary arch distalization [34-40].

CONCLUSION

The current literature on molar distalization using clear aligner treatment should be interpreted with caution, as studies vary in their outcome measurement methods and timing. Some studies assess distalization outcomes immediately after the molar distalization process, without accounting for potential anterior anchorage loss, while others report findings after the entire treatment, including anterior en-mass retraction, is completed. Most of these studies are retrospective and involve small sample sizes, which may introduce some bias. As a result, prospective randomized trials with larger sample sizes are needed to draw definitive conclusions.

While reports indicate that 2–3 mm of molar distalization is achievable, it is important to distinguish between bodily movement and backward molar tipping, and further investigation is needed in this area. When using clear aligner treatment for molar distalization, it is crucial to reinforce anterior anchorage with appropriate auxiliaries, such as composite attachments, Class II/III elastics, and TADs. Similar anchorage loss has been observed in distalized molars as the anterior teeth are retracted. Additionally, several studies have shown discrepancies between computer-assisted predicted outcomes and actual clinical results with clear aligner treatment. Therefore, case refinement and adjustments to treatment duration should be discussed with patients during the planning phase.

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