



Review Article

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## ***Effect of Invisalign on the Treatment of Mild to Moderate Overbites Cases; A Literature Review***

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### ABSTRACT

The growing popularity of Invisalign is attributed to the fact that patients find it more aesthetically pleasing than the traditional fixed appliance to have their teeth straightened using the Invisalign system. Invisalign was initially intended for use in less severe conditions of orthodontic malalignment. Invisalign has been an effective and aesthetically acceptable alternative to conventional labial fixed appliances since its launch in 1997. CAD/CAM (Computer-aided design/computer-sided machine) stereolithography and a single silicone or digital impression can be used to make a set of custom aligners. Each aligner is set to gradually shift teeth by 0.25 mm to 0.33 mm over two weeks. More individuals are now receiving orthodontic treatment due to this novel tooth mobility approach. Over 300,000 patients have been treated with Invisalign in the previous decade, with the average patient age being 19.5. In most cases, the Invisalign device can stabilize these patients' anterior, posterior and vertical dimensions. Although many dentists and orthodontists believe that Invisalign appliances cause deep bites, this research disproves this theory. This literature review will determine the level of efficacy Invisalign can offer when it comes to the treatment of deep bites. It was concluded that Invisalign is effective in treating mild to moderate overbite cases and is an effective replacement for metallic braces, and provides a good option for esthetic-conscious patients.

**Key words:** *Invisalign, Overbite, Orthodontics, Esthetics*

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### INTRODUCTION

Invisalign (Align Technology, Santa Clara, California) is an orthodontic device made of a series of translucent, plastic shells developed by a computer to fit snugly over the teeth and gradually shift their position into proper alignment. The growing popularity of Invisalign is attributed to the fact that patients find it more aesthetically pleasing than traditional fixed equipment to have their teeth straightened using the system. Invisalign was initially intended for use in less severe instances of orthodontic malalignment. Nonetheless, Invisalign has been used to treat complicated orthodontic cases, as reported in the literature [1]. For example, recent research showed that an anterior open bite might be closed by extruding the anterior teeth using a sequence of 35 Invisalign aligners, restoring proper jaw alignment. Practitioners quickly picked up on the fact that the Invisalign device often generated a deepening of the overbite soon after its launch in the late 1990s [1]. It was

proposed that full-arch aligners might intrude on the back teeth by acting as a bite block. This would cause a decrease in the vertical dimension at the back of the mouth and a deeper overbite. Throughout Invisalign's 16-year history, many methods have been used to control the vertical dimension. The reduction of occlusal covering on the second molars was an early method for preventing bite deepening. Align Technology has created cutting-edge new treatment solutions, like virtual bite ramps and specialized attachments, to serve patients' needs better [2]. To aid in tooth movement, attachments—composite buttons bonded to the labial surfaces of teeth—come in various sizes and forms. These fasteners improve retention, convey positive force to the teeth, and facilitate additional tasks like elastic insertion. Virtual bite ramps help you quickly chew and swallow food like bite plates and turbos. When patients bring their teeth together, the biting ramps built into the maxillary aligner contact the mandibular incisors, dislodging the back teeth [2].

Recent advances in orthodontics have been paralleled by a commensurate rise in patients' emphasis on aesthetics. Because orthodontic equipment may drastically alter a person's look, many patients feel compelled to actively participate in shaping their treatment plan and its ultimate goals. Patients seeking orthodontic treatment often express anxiety about their looks being negatively affected by traditional orthodontic techniques. Since this is a problem, several aesthetic materials and procedures have been implemented in clinical practice [3].

Invisalign has been an effective and aesthetically acceptable alternative to conventional labial fixed appliances since its launch in 1997. CAD/CAM stereolithography and a single silicone or digital impression can be used to make a set of custom aligners. Since the system's debut, novel attachment designs, materials, and ancillaries like "Precision Cuts" and "Power Ridges" have been developed and refined to enable new treatment biomechanics. Large tooth movements, such as a 50° derotation of bicuspid or a 4 mm root movement of the upper central incisors, are said to be possible with Invisalign, according to the company that makes the aligners. Claims of the treatment's effectiveness have been met with skepticism in the medical community [4].

#### *Construction of invisalign*

Align Technology Inc. (Santa Clara, CA, USA) creates the Invisalign® system employing CAD-CAM and 3-D modeling technology. The polyurethane "aligner" may be used to fix various malalignments. It's designed to operate without wires or metal attachments often seen in permanent home appliances. Only certified medical professionals are allowed to utilize this technology. After becoming certified, the dentist chooses the patient to be treated, diagnoses the problem, plans the treatment, and sends the following information to Align technology: a polyvinylsiloxane impression (addition silicone) made in a metal tray or a non-metal tray (**Figure 1**) from Invisalign (it should be noted that the company suggests using only their plastic trays), a bite registration, in maximum intercuspation, a panoramic radiograph, a lateral cephalometric. Using CAD (Computer-aided design), virtual adjustments are accomplished by scanning (destructive scanning) the imprints to generate a three-dimensional model of the patient's dental arches and occlusion. When the doctor receives the virtual file (ClinCheck), they may review it and request any necessary adjustments before finalizing the treatment plan. After the ClinCheck is complete, the patient's aligner models are created using stereolithography and CAM (Computer-Aided Manufacturing) (**Figure 2**).

No occlusal or interproximal interference will occur during the company's guaranteed slow tooth movement (linear movement: 0.25mm/month; angular movement: 2o/month). Thus, the treatment cost varies from case to case since the number of aligners required to accomplish the basic movements is conditional on the intricacy of such movements. About 45 days after the doctor approves the ClinCheck, the patient will get all their aligner (**Figure 3**). The patient should be reminded that they cannot stop therapy and resume using the same aligners later. The treatment of mild to moderate crowding (1-6 mm), mild to moderate spacing (1-6 mm), dental cross-bites (non-skeletal), and relapse from earlier orthodontic treatment are all appropriate indications for Invisalign [5]. Complex procedures have been documented, including extractions, distal movement, deep bites, and periodontal conditions. This is likely the result of technological advancements that have made it possible for all teeth to move in unison. Attachments may be utilized for extrusion, rotation, translation, and torque control to improve the stability of the aligners during Spee curve correction. The most effective therapy method is to replace the aligners every two weeks since this reduces any discomfort associated with aligner changes. The aligners should be worn for a minimum of 20 hours daily and taken out only to eat and clean the teeth and brush with toothpaste and a toothbrush to clean them. The final aligner may be worn in the upper arch, and a 3x3 fixed retainer can be worn in the lower arch for retention once treatment is complete [6].



**Figure 1.** A polyvinylsiloxane impression (addition silicone) made in a metal tray or a non-metal tray



**Figure 2.** aligner models are created using stereolithography and CAM



**Figure 3.** Placement of Invisalign

#### *Advantages*

Compared to traditional braces, the Invisalign system has several benefits, including better aesthetics, user-friendly, comfort, cleanliness, and visibility in the ClinCheck. Since patients have previously seen and authorized their ClinCheck, there is a low risk of treatment-related dissatisfaction. Removable aligners have several drawbacks, including a lack of root movement and extrusion, and Invisalign® therapy is not an excellent choice for everyone. Patients reported less discomfort and fewer disruptions to their daily activities throughout the first week of using aligners compared to traditional fixed-appliance therapy. However, the relapse rate was more significant during the post-treatment phase, at a rate of 23% [7].

#### *Progression of tooth movement*

The average precision of tooth movement with Invisalign was 41%. Extrusion (29.6%), especially extrusion of the maxillary (18.3%) and mandibular (24.5%) central incisors, followed by mesiodistal tipping of the mandibular canines (26.9%), was the minor accurate movement. Lingual constriction (47.1%) was the most accurate. Compared to the other teeth' accuracy, canines rotated the least, with the maxillary lateral incisors

being the only exception. The precision of the maxillary canines' rotation decreased dramatically for rotational motions higher than 15 degrees. For maxillary incisors, a palatal crown tip proved far more precise than a labial one. For all indications examined, there was no statistically significant difference in accuracy between maxillary and mandibular teeth of the same tooth type [8].

#### *To what extent does Invisalign straighten teeth?*

As an aesthetically preferable replacement for traditional fixed labial braces, Align Technology (Santa Clara, California) released Invisalign, a set of removable polyurethane aligners, in 1998. Using CAD/CAM stereolithographic technology, the Invisalign system can predict therapy and produce several bespoke aligners from a single imprint. Each aligner is set to gradually shift teeth by 0.25 mm to 0.33 mm over two weeks. More individuals are now receiving orthodontic treatment due to this novel tooth mobility approach. Over 300,000 patients have been treated with Invisalign in the previous decade, with the average patient age being 19.5. While the demand for and usage of Invisalign continues to rise, concerns have been raised about the system's effectiveness. Do teeth move effectively with detachable aligners? According to Align Technology, between 20 and 30% of Invisalign patients may need adjustments midway through treatment or more impressions to fully realize their desired outcomes. 2 Orthodontists estimate that anywhere from 70 to 80% of their patients will require some midcourse adjustment, case refinement, or switch to permanent appliances [9].

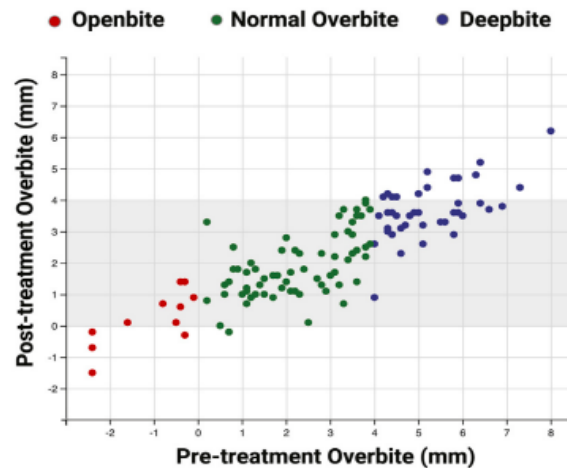
The first cohort research was conducted by Djeu and colleagues, who used the American Board of Orthodontics (ABO) objective grading method to compare the treatment outcomes of Invisalign patients to those of traditional fixed appliances. Invisalign patients had a higher mean score and a lower passing rate than those with traditional braces (-27% points). After treatment, patients had considerably lower Invisalign ratings for reducing posterior torque [10].

Occlusal contacts, anterior-posterior occlusal connections, and overjet have all been examined in previous research. Patients treated with Invisalign or traditional fixed appliances were compared using the ABO objective grading system in a follow-up research conducted by Kuncio and colleagues in 2007 [11]. Patients who participated in the 2005 treatment outcome research using Invisalign made up the Invisalign group. The authors found that relapse was more common in the maxillary front teeth of Invisalign patients than in those treated with fixed appliances. Bollen *et al.* conducted the first clinical study to evaluate the efficacy of Invisalign by contrasting the effects of material stiffness and activation frequency on the rate at which patients completed treatment [10]. The authors found that patients were likelier to finish their first set of Invisalign aligners if activated every two weeks, had no extractions scheduled, and had a low peer evaluation rating score. Patients with two or more premolars extracted had an overall 29% completion rate for their first aligners. There was a need for either further case refinement or a switch to fixed appliances for every patient who finished their first set of aligners. Clements *et al.* examined the effects of material stiffness and activation frequency on the quality of therapy assessed by changes in peer evaluation rating in the second clinical experiment. Researchers found that aligners worked best to correct overbite and underbite, performed reasonably well to correct midline and overjet, and performed poorly to correct buccal occlusion and transverse connections. Space closure was much better at single mandibular incisor extraction sites than at single maxillary or single mandibular premolar extraction sites [12]. Independent prospective clinical research on Invisalign began with the landmark studies by Bollen *et al.* and Clements *et al.* Neither research tested the success of tooth movement with Invisalign using aligners that were like the aligner material now utilized by Invisalign. Further clinical studies are required to fully understand the benefits and drawbacks of Invisalign therapy [12, 13].

#### *Effect of invisalign treatment on overbite case*

In most cases, the Invisalign device can stabilize patients' anterior and posterior vertical dimensions. Although many dentists and orthodontists believe that Invisalign appliances cause bite deepening, this research disproves the theory. Practitioners' everyday observations and early study results revealed that the Invisalign device intrudes posterior teeth during treatment, subsequently deepening the overbite.

Current data suggest that even those with typical overbites tend to have a slight extrusion of their rear teeth. Maintenance of the posterior vertical dimension, despite this device's bite-block impact, may be partly attributable to advancements in the Invisalign process, such as virtual bite ramps. One possible other reason is that orthodontists are taking measures to prevent overbites from becoming more severe as a result of therapy. Our second goal was achieved, showing that most patients had their overbite reduced to normal levels (**Figure 5**). Most individuals whose overbites were within the normal range before therapy maintained that position [14].



**Figure 4.** Overbite before and after orthodontic treatment plotted on a scatter diagram (n 5 120).

Cephalometric radiographs were taken before and after treatment to assess overbites, and a graph was created to see whether there was any correlation between the two. Patients whose overbites are within the usual range (shown by green dots) tend to remain there (gray zone). Furthermore, our findings suggest that overbite improved in all patients with deep bites (blue dots) and open bites (red dots), with the majority of patients achieving an overbite between 0 and 4 mm, which may be within the range of typical overbites [15].

Minimal shifts were seen in the anterior vertical dimension in individuals with a normal preoperative overbite (**Figure 4**). For this sample, a 0.3 mm increase in overbite was the median. Further, Researchers found evidence for slight proclinations of both the maxillary and mandibular incisors. However, this was only statistically significant for the maxillary incisors (DU1-NA 5 0.7 and DL1-NB 5 0.6). There was a statistically significant rise of 0.7 mm in the height of the face's anterior region. This shift, however, was well within the margin of error for the associated measurements. Comparable to the front vertical dimension, the posterior vertical dimension was mainly preserved in the distinct overbite group. Within the margin of error for angle measurements, the median change in the mandibular plane was 0. Patients with deep bites before treatment had their overbite corrected with the Invisalign device. We measured a median overbite opening of 1.5 mm among those with deep bites [16]. Proclination of the mandibular incisors and intrusion of the maxillary incisors appear to be the critical mechanism responsible for overbite reduction in this population. Within the margin of error for our measurements, we found that the first and second molars in the mandible had extruded by 0.5 mm on average. There were also shifts in the angle formed by the mandibular bone. When considering the whole picture, patients whose overbite was profound before therapy could see significant improvement. Typically, a person's bite would open by proclaiming their mandibular incisors. In individuals with an open bite before treatment, the Invisalign device significantly increased the overbite [17, 18].

#### *Findings from clinical studies*

##### *Accuracy*

Nine studies [19, 20] reported the accuracy of Invisalign®, defined as the discrepancy between the actual and desired tooth motions. Contradictory results were found in upper incisor root control. Inadequacies were found in the bodily expansion of the posterior maxillary teeth, rotational movements of the canine and premolar, extrusion of the maxillary incisors, and control of the overbite.

##### *Comparing invisalign® to conventional braces*

Results from Invisalign® orthodontic treatment were compared to those from traditional fixed appliances in seven studies. Retrospective research confirms the findings of a previous randomized controlled trial that demonstrated no statistically significant difference in the degree of mandibular incisor proclination caused by Invisalign® and fixed labial appliances in moderate crowding patients. Invisalign had comparable results to traditional braces for mild to moderate malocclusions, according to a study by Gu *et al.* but it took much less time to complete [21]. However, Djeu *et al.* and the current study agree that Invisalign's performance declines with the increasing severity of the problem [22]. Similar findings were reached by Khosravi *et al.* in their RCT

trial on class I adult extraction patients; however, they found that Invisalign took longer and was less effective at correcting buccolingual inclination and occlusal contacts [23]. Two other retrospective investigations using just Invisalign groups corroborate the latter results.

#### *Invisalign groups only*

Torres found that, with proper treatment planning, Invisalign is more effective for individuals with mild to moderate malocclusions in the permanent dentition. Similar results were seen in an earlier exploratory RCT study, which found that Invisalign had a higher likelihood of success when used to treat milder malocclusions without the extraction method [24].

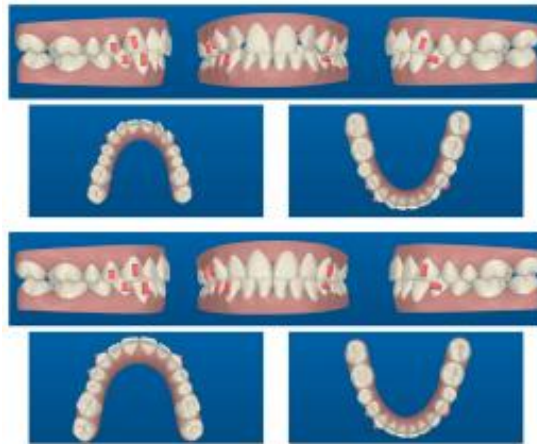
Different groups of Invisalign patients were also studied in three recent retrospective investigations. Invisalign's capacity to treat overbite was only partially shown in that study [25]. Mandibular incisor proclination helped preserve a normal overbite while partly correcting a deep bite. Incisor extrusion was also used to fix open bites but to a lesser extent. However, another research [26] found that Invisalign might physically distal maxillary molars in non-extraction moderate class II instances (1/2 cusp) in adults without causing any alterations to face height. Finally, third research [27] shows that Invisalign may effectively treat mild to moderate crowding in non-extraction patients without significantly altering the position or inclination of the mandibular incisors. Instead, these adjustments (protrusion and proclination) were elicited in situations with severe crowding (6 mm).

#### *Clinical Case*

A 26-year-old lady came in with an orthognathic profile and a Class I malocclusion. Her maxillary central incisors were retroclined, her overbite was moderate, there was space distal to her maxillary canines, and her mandibular arch was mildly crowded (**Figure 5**). Her maxillary incisors were her main worry, and she refused to employ permanent appliances. Invisalign was used to fix her uneven front teeth, overbite, and the crowding in her lower jaw (**Figure 6**). Keeping the Class I buccal segments in place, achieving a normal overbite and overjet, and achieving a functioning occlusion were the occlusal objectives [28]. There were 24 aligners for the top teeth and 10 for the lower teeth in my Invisalign® treatment. Multiple teeth were attached so that the aligners could shift the teeth in a more controlled manner. To shorten the duration of treatment, the patient was told to follow the prescribed schedule of changing the aligners every ten days instead of every 14 days. It took eight months of primary treatment, followed by a case refinement with seven more aligners to complete the maxillary arch. A bonded palatal fixed retainer was inserted to prevent the maxillary incisors from shifting back into their original positions once treatment was finished (**Figures 6 and 7**). The patient was fitted with a modified spring aligner for the mandible and a maxillary Hawley wrap-around for retention. The patient was instructed to use the detachable appliances constantly for six months and, after that, just at night [29].



**Figure 5.** Clinical photographs before the treatment



**Figure 6.** CAD/CAM image of the patient's case



**Figure 7.** Clinical photographs after the treatment

## CONCLUSION

Invisalign is effective in treating mild to moderate overbite cases, is an effective replacement of metallic braces, and provides a good option for esthetic-conscious patients.

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