



Fig. 1: Patient wearing aligners



## AN ESTHETIC AND REMOVABLE ORTHODONTIC TREATMENT OPTION FOR PATIENTS: INVISALIGN®

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**T**echnology has revolutionized the range of possibilities with orthodontic treatment, from imaging to appliance fabrication. State of the art three-dimensional technology and a unique manufacturing process developed by Align Technology, Inc. has provided the clinician with opportunities for comprehensive orthodontic treatment using a large number of esthetic and removable aligners (Figure 1). The concept of moving teeth with clear vacuum form appliances is not new to orthodontics. Kessling<sup>1</sup> and Nahoum<sup>2</sup> introduced this concept, Sheridan<sup>3</sup> and others<sup>4,5,6</sup> have built upon it, but movements were still limited to a few millimeters. Computer software graphics and manufacturing technology can produce no two aligners that are the same, and for this reason patients can be treated using a series of early invisible aligners moving teeth from initial to final position incrementally.

The treating clinician begins by sending to Align Technology maxillary and mandibular polyvinylsiloxane (PVS) impressions, a bite registration, photographs, and

x-rays in addition to a web-based treatment prescription form. Plaster models are poured and the scanning process begins. A computer communicates with the scanner compiling the layers to create a virtual 3-D image on the computer. The company's virtual orthodontic technicians (VOT) separate the individual teeth using custom-designed software tools. The VOT then moves the individual teeth from initial position to final position based on the treating clinician prescription using proprietary company software, Treat®. A viewing program (ClinCheck™) gives the clinician an opportunity to review the treatment via the Internet. Once the case is confirmed by the treating clinician, the aligners are manufactured using a CAD/CAM (computer-aided design/computer-aided manufacture) process. Each virtual treatment stage is converted into a physical model using laser cured plastic resin. Once these three-dimensional models of the treatment are created, a thermoforming process is used to fabricate the aligners. The aligners are then laser etched, trimmed, polished, and disinfected before being shipped to the treating clinician's office (Figure 2).

Many adults want straighter teeth. One of the obstacles adults face is the unesthetic nature of fixed appliances. Although clear, fixed appliances have been introduced, the wire that engages in the brackets remains

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very visible. Lingual appliances may be used for the esthetically conscientious patient, however Invisalign is equally esthetic with the added benefit of being removable and comfortable. Patients can eat what they wish and maintain their normal hygiene practice, since brackets and wires are not an impediment during brushing and flossing. Invisalign is appropriate for patients with a fully erupted dentition (excluding third molars), which typically occurs by age 14. Applicability for Invisalign, dictation of the treatment plan, and final acceptance of ClinCheck are all determined by the treating clinician. The following two cases were treated using Invisalign.

### Case Reports

**CASE 1** (Courtesy of Dr. Bishop): A 17 year old female presented with the chief concern of “upper spacing and lower crowding”. All hard and soft tissues were healthy. She did present with some thin attached gingiva in the area of her mandibular canines.

**Diagnosis:** She presents with pleasing and well-balanced facial esthetics. The maxillary midline was centered to the face and the mandibular midline was shifted 2mm to the left. Molars and canines were in Class I with moderate overjet and overbite. There was moderate maxillary spacing and moderate mandibular crowding. She did have a retained mandibular primary left second molar (Figure 3).

**Treatment Objectives:** The objectives were to maintain the Class I occlusion while alleviating the mandibular crowding through a combination of proclination and interproximal reduction. This would prevent excessive proclination of the mandibular incisors



Figure 3: Initial photos for case #1



Figure 2: Aligners and SLA models

due to the nature of the thin attached tissue. Other objectives were to reduce the overbite through intrusion of the mandibular anteriors. The maxillary incisors were not intruded because of her nice smile. Extrusion of her maxillary laterals and canines was attempted to achieve the esthetic alignment of the maxillary anteriors. All maxillary spacing was to be closed and the primary left second molar retained. Figure 4 shows the final stages of ClinCheck.

**Treatment Results:** This case was treated with Invisalign. Treatment comprised of 15 maxillary aligners and 18 mandibular aligners. Aligners were changed once every 2 weeks and the patient was seen once every 6 weeks for monitoring. Maxillary treatment time was 7 months and mandibular treatment time was 9 months. The Class I occlusion was maintained. All maxillary and mandibular teeth were aligned, the maxillary spaces were closed and the

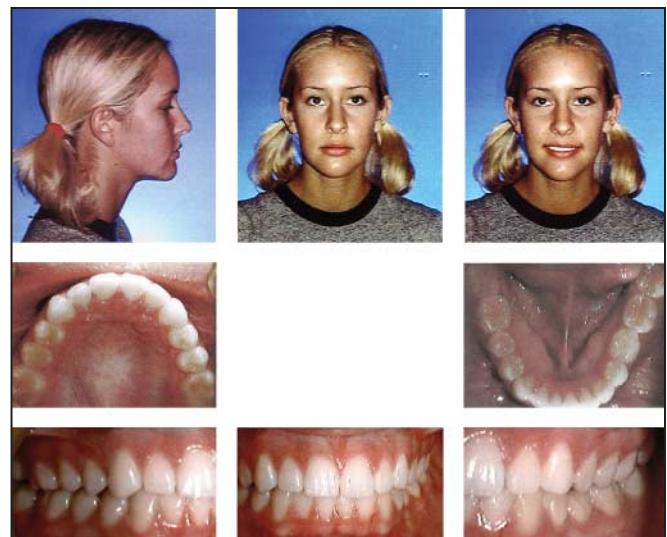


Figure 4: Final photos for case #1

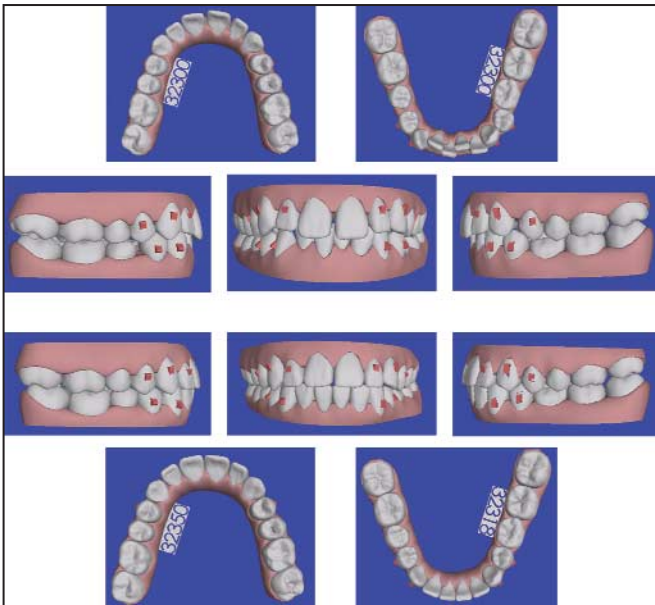


Figure 5: Initial and final stages of ClinCheck for case #1 mandibular crowding resolved. The overbite was reduced and the mandibular midline was shifted to the right; the midlines are slightly off. The maxillary right second premolar rotation could have been more complete (Figure 5). Her oral hygiene was maintained throughout treatment since the removable appliances allowed the patient to maintain her oral hygiene practice.

**Discussion:** In this case, attachments were placed on mandibular canines and first premolars to aid with intrusion of the mandibular incisors. Attachments were also placed on the maxillary laterals and canines for extrusion and the maxillary premolars for rotations. The maxillary right second premolar was not fully



Figure 6: Initial photos for case #2

rotated. It is important to request overcorrection when submitting an Invisalign case to compensate for possible aligner lag. In this case, it would have been wise to overcorrect all rotations by about 10%. The patient was very pleased with the results of treatment and the timely nature of treatment.

**CASE 2** (Courtesy of Dr. Womack): This 34 year old female's chief concern was that she had "upper and lower crowding". She has history of previous restorative work and bilateral mandibular tori present.

**Diagnosis:** Facial analysis reveals symmetrical structures. Upon smiling, she has a good lip line to show tooth relationship. In the profile view, lips are full and there is minimal strain upon closure. Molars and canines are in Class I occlusion. There is minimal overjet and overbite. The mandibular canines are rotated out distally. There is 3mm of maxillary crowding and 5mm of mandibular crowding. The midlines are coincident (Figure 6). Her panorex is within normal limits (Figure 7).

**Treatment Objectives:** The objectives in this case were to resolve the maxillary crowding with interproximal reduction. Her maxillary central incisors were broad and could be reduced interproximally for esthetics to a more favorable width-to-height ratio. The mandibular incisor crowding was to be resolved with an extraction of the mandibular right central incisor. The mandibular right central incisor was chosen due to the slight recession present as compared to the other teeth. With the retraction of the mandibular incisors, positive overjet and overbite can be achieved. Since her right mandibular incisor will be extracted, her

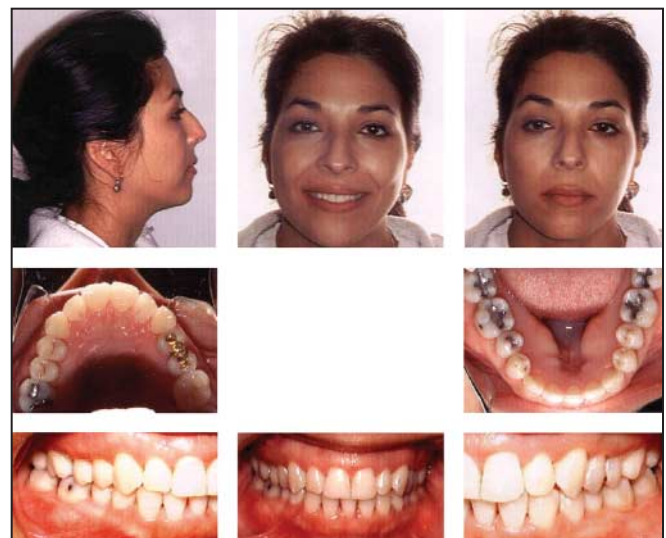


Figure 9: Final photos for case #2



Figure 8: Initial and final stages of ClinCheck for case #2

mandibular midline would be centered on the remaining central incisor. The buccal occlusion should be moved minimally, given the nice original occlusal relationship. Figure 8 shows the initial and final stages of ClinCheck. The final stage also serves as the diagnostic set-up. It can be seen that the case would finish out nicely with a mandibular incisor extraction and maxillary interproximal reduction.

**Treatment Results:** Treatment consisted of 21 maxillary aligners and 21 mandibular aligners. Attachments were placed on the mandibular canines to aid with rotations. Aligners were changed once every 2 weeks and the patient was monitored once every 6 weeks. The Class I occlusion was maintained and the treatment objectives met. The maxillary and mandibular crowding was resolved; positive overjet



Figure 7: Initial Panorex for case #2

and overbite were achieved. The midline was centered on the middle of the remaining central incisor. The lower canines were de-rotated; the attachments may have helped with the rotations (Figure 9). The post-treatment panograph show good root parallelism in the extraction site (Figure 10). With mandibular incisor extractions, the use of root tip attachments on the teeth adjacent to the extraction site may be used to aid with tip control.

**Discussion:** The objectives in this case were met and the result was very nice. The patient was treated in 10 months with an esthetic and removable treatment modality. The oral hygiene was excellent. The maxillary left canine could have been rotated slightly mesial in. Again, this overcorrection could have been requested when submitting the case.

**Conclusions:** Both cases show nice results meeting the orthodontists' treatment goals as well as providing an esthetic treatment modality. In addition, patients were able to maintain their oral hygiene with the removable appliance.

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Figure 10: Final Panorex for case #2