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Invisalign: Meeting Challenges with Newer Technologies

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Abstract---Orthodontic developments, especially during the last few years have been accompanied by a significant increase in the esthetic demands of the patients. As the demand for esthetic treatments is increasing, more people are seeking alternatives to fixed orthodontic appliances. Clear aligners provide an excellent solution as compared to fixed orthodontic appliances in terms of esthetics and comfort to the patient. In 1998, Align Technology (Santa Clara, Calif, USA) introduced Invisalign, a series of removable polyurethane aligners, as an esthetic alternative to fixed orthodontic appliances.

Keywords---invisalign, smart force technology, align technology, stereolithography.

Introduction

The Invisalign system is a virtually invisible treatment that uses an innovative approach to gently yet effectively straighten the crooked teeth. The Invisalign System moves the teeth to the desired position through a series of custom-made removable aligners made with unique Smart Force technology. Invisalign is a brand of clear aligners manufactured by Align Technology and has been used to treat more than 9 million patients.¹



Figure 1. Invisalign

Historical perspective

Chishti conceived of the basic design of Invisalign while treating an adult orthodontic patient. During his treatment with a retainer intended to complete his treatment, he noticed that a series of such devices could affect a large final placement in a series of small movements. He partnered with Kelsey Wirth to seek developers^{2,3,4}. Invisalign was approved by the Food and Drug Administration in 1998 and sales began in the U.S. in 1999.⁵ Initially Orthodontists were reluctant in adopting this system because the founders did not have any knowledge or experience about the subject but the product became popular among consumers.²

In the early 2000s, Align Technology was spending nearly all of its revenues on marketing and advertising and losing about \$18 million per year.^{6,7} Its cofounders Wirth and Chishti resigned from Align technology in 2001 and 2003 respectively,⁸ with Thomas Prescott replacing Chishti as CEO in March 2002. He re-focused the company on North America and cut the marketing budget to about one-third its original size^{6, 7}. The Invisalign System grew from 80,000 patients in 2002 to 175,000 in 2004. It won several awards for stereolithography, medical design and fast growth. Align Technology was profitable for the first time in 2003. In 2005, the company expanded into Japan, and acquired General Orthodontic, an orthodontics firm that supported doctors prescribing the Invisalign system. Later that year the Harvard School of Dental Medicine began requiring that its orthodontic graduate students complete Invisalign certification before they graduate.⁶

The Invisalign Express 10, which uses 10 aligners, was introduced in 2005.⁹ Invisalign 1.5 was released in 2009. It was followed by Invisalign G3 in 2010 and G4 in 2011. Both G3 and G4 were designed for more complex treatments. An Invisalign Express 5 version, which uses 5 aligners, was introduced in 2012.¹⁰ In February 2014, Align Technology released a G5 product designed to treat deep bite cases.¹¹ Support, software engineering, pre-production and administrative functions are done from Align Technology's headquarters in California. The manufacturing of Invisalign aligners is performed in Mexico⁴ and treatment plans are created in Costa Rica. Align Technology also operates separate subsidiaries in Hong Kong and Australia that sell Invisalign in their respective markets.¹² Align Technology provides training and certification to doctors.^{5,13}

How does the Invisalign System work?

- Initially, an Invisalign-trained doctor takes the photographs, radiographs and digital scans or a dental impression to help create the treatment plan.

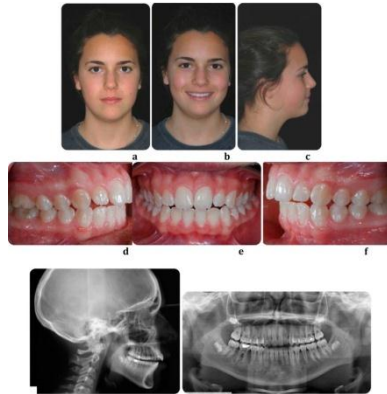


Figure 2. Initial treatment records of the patient

- The makers of Invisalign clear aligners use these records, along with the treatment prescribed by the orthodontist to create a customised 3D treatment plan just for the patient. With the treatment plan, the patient is able to see the final position of their teeth as are predicted to reach after the completion of the treatment. This treatment plan is then used to develop the customised aligners and also estimate the likely length of the treatment.

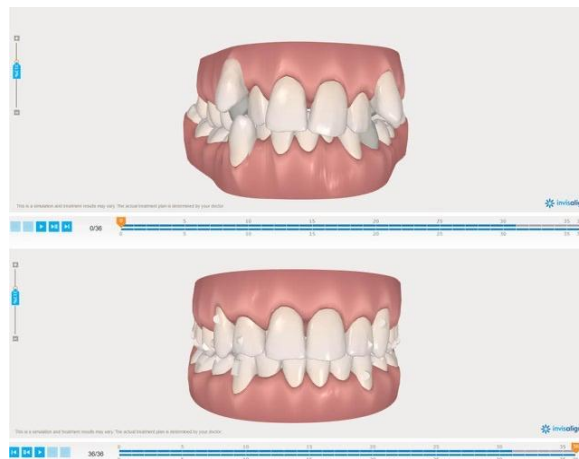


Figure 3. Showing the patient customised 3-D treatment plan

- The customised aligners are then manufactured and shipped to the concerned Orthodontist office.



Figure 4. Customised Invisalign start up kit for the patient

- The concerned Orthodontist calls the patient for the initial appointment and bond all the necessary tooth attachments which are required for the necessary tooth movement to be carried out.

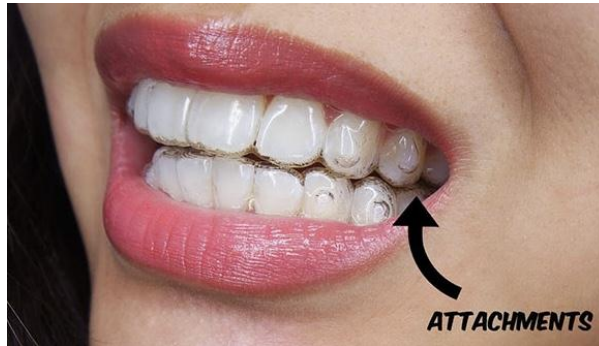


Figure 5. Bonded tooth attachments

- The series of custom-made aligners are provided to the patient (approximately 3-4 sets at a time) for them to wear everyday and change them at home after every 1 week.
- The patient is required to visit the concerned Orthodontist every 6-8 weeks to monitor the progress of the treatment and receive the next series of aligners.
- After the patient has finished with Invisalign aligner treatment, he or she is required to wear retainers to help make sure the new position of their teeth is maintained.

Indications¹⁴

- Mildly crowded and malaligned problems (having a discrepancy of 1-5mm)
- Presence of spaces (1-5mm)
- Deep overbite problems
- Widening of the narrow arches
- Relapse cases
- Minor rotations

Contraindications¹⁴

1. Severely crowded or spacing present over 5mm
2. Skeletal antero-posterior discrepancies of more than 2 mm
3. Centric-relation and centric-occlusion discrepancies
4. Severely rotated teeth
5. Anterior and posterior open bite cases
6. Extrusion of teeth
7. Severely tipped teeth

Advantages of Invisalign treatment

1. Invisalign aligners are removable, so it is easier to clean teeth and maintain the oral health during treatment
2. Invisalign treatment may give visible results from as early as the first month of treatment. Most of the people won't know that the treatment is going on because they are virtually invisible.
3. Invisalign aligners are more comfortable than traditional braces
4. Invisalign aligners require few dental visits
5. Invisalign aligners can also prevent other dental problems. When left unchecked, gum disease can cause tooth decay and loss. Crooked teeth and abnormal bites can create sleeping problems such as sleep apnea. Making sure the teeth are straightened with a removable aligner that allows for great dental hygiene will allow one to prevent worse dental issues.
6. Invisalign treatment uses a non-invasive scanning measure for evaluating the patient's teeth
7. These Invisalign aligners are made from clear resin to perfectly fit ones teeth. Using an Invisalign aligner can help the person get straight teeth to boost confidence and dental health while also protecting them from getting teased by their near ones
8. With Invisalign aligners person can eat or drink any food they love to unlike traditional braces where the person has to limit themselves to eat only restricted food and drink
9. Invisalign treatment requires a shorter treatment period then the traditional braces



Figure 6. Invisalign Versus traditional metal brackets

Disadvantages of invisalign treatment

- To get the maximum benefit from Invisalign treatment, one must wear the aligners for 20 to 22 hours a day. If a person slips them out more often, it may not be the best choice.
- One needs to take the aligners out while eating or drinking. If not, then the food or drink can get into them which cause bacteria to grow along the teeth or gum line and could lead to cavities.
- Expensive than the traditional braces
- These aligners cannot be used in patients having parafunctional habits like clenching or grinding of teeth

Conclusion

Invisalign aligners offer a technologically advanced way to transform smiles more predictably and gently. Invisalign appliance can provide an excellent esthetic during treatment especially for adults, ease of use, comfort of wear and superior oral hygiene.¹⁴

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