

GAME CHANGER IN ORTHODONTICS - A CLEAR ALIGNER REVIEW

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INTRODUCTION

With the advancing developments in every nook and corner of medical science and dentistry, the field of orthodontics has also changed in recent years. Digital imaging and computers have improved the diagnostic process. The introduction of prescription brackets, bonding, NiTi and other alloy wires have improved the treatment productivity and efficacy. Adult patients looking for orthodontic treatment are progressively propelled by aesthetic considerations. Most of these patients reject wearing labial fixed steel appliances and are looking rather to more aesthetic treatment alternatives, including ceramic braces, lingual orthodontics and clear plastic aligners. The change in perspective in orthodontics has led to the introduction of Aligner System.

The aesthetic and useful benefits of the system have stretched out orthodontic services to a greater populace. The two contemporary frameworks for moving the teeth with plastic appliances are the ALIGNER and ESSIX SYSTEM.

Clear plastic tooth moving appliances are incredible and brilliant options for adults or adolescents who is probably hesitant to wear the fixed appliances and who will observe clinicians' instructions, and whose main objection revolves around mild to moderate alignment issues.

This discipline of orthodontics requires the bare necessities of essential elements of orthodontic tooth movement-force, space and time. The clinician can control two of these essential prerequisites – force and space. As with any dynamic removable appliance, the patient must provide the third essential – time. Therefore, the target population that is most eligible for tooth movement with plastic appliances are adults as they are more complaint.

EVOLUTION OF CLEAR ALIGNERS

Documented use of vacuum formed removable appliances to move teeth has been available since the 1940s, and their use in the dental office may have occurred even earlier than that. In 1945, **Kesling** introduced the tooth positioning appliance, which is often used today to refine the occlusion after fixed appliance treatment.

Henry Nahoum (1950) developed the vacuum formed dental contour appliance often termed as the “invisibles”. With the transformation of clear aligners, **Ponitz Of Ann Arbor, Michigan (1971)** introduced so-called “invisible” retainers. Typically, this retainer was formed from a sheet of thin Biocryl. In the 1990s, **Sheridan** popularized the "**Raintree Essix**" overlay appliance as a retainer and an active orthodontic appliance.

The story doesn't end here. In April 1997, **Kelsey Wirth** and **Zia Chishti**, two MBA students from Stanford University founded Align Technology. The concept on which the company was founded came from Chishti, who had undergone adult orthodontic treatment, but like many patients was not consistent in wearing his clear retainer. After experiencing re-crowding of his mandibular teeth, Chishti returned to wearing his overlay retainer, and this realigned his anterior teeth. Frustrated with the relatively slow and modest progress achieved with his Overlay retainer, Chishti came up with the idea of using multiple appliances and computer imaging technology to effect major tooth movements. Align technology was founded to develop the next generation aesthetic appliance. This innovative approach combines orthodontic principles with three-dimensional computer and mass customization technologies. From this revolutionary concept, Chishti and Wirth, two Orthodontists, along with a software engineer, formed Aligntechnology.

Clear aligner innovation has developed in the course of the most recent 15 years, with these appliances ceaselessly being altered to amplify the scope of tooth movements that they can accomplish. However, until more clinical research becomes available, aligners cannot be routinely prescribed as an effective alternative to fixed labial appliances.

FABRICATION

At the appointments prior to debonding, the arch wires are removed and impressions are taken. A wax interocclusal record and facebow mounting should also be obtained.

The records obtained are sent to the laboratory for the manufacture of the tooth positioner. Suitable detail instructions for the laboratory should be included.

The clinical records consist of:

1. Upper and lower impressions
2. A facebow record
3. An interocclusal record

4. Additional records like lateral cephalogram may be taken to assist tooth positioning.

Laboratory procedures:

- Mounting of models into anatomical articulator.
- Resetting the required teeth
- Duplication of the reset models
- Mounting of the duplicate models

Once the duplicate models are remounted, the tooth positioner is made over it. Thermoplastic materials seem to have been most popular for fabrication of tooth positioner.

Thermoplastic sheets are heated and adapted over each duplicated model. Once a mouthguard is made accurately to fit each arch, they can be joined. The articulator is then opened, the mouthguards are heated on their occlusal surfaces, any necessary fill is placed and softened, then the articulator is closed in predetermined position.

When cooled, the tooth positioner is removed from the models. The buccal, lingual and distal extensions may be trimmed with scissors or a large bur.

The positioner is then replaced on the models and its accuracy of fit is checked. The surface finish for PVC materials is achieved with gentle brushing strokes from a small flame.

The amount of gingival coverage may be varied according to patient needs or preferences. The most suitable degree of gingival coverage is about 3 mm. A greater coverage may produce patient discomfort, while less coverage reduces the retention of the positioner in the mouth.

FORCE GENERATION

With Essix tooth moving mechanics, the clinician has the option of placing the force wherever on the crown surface to achieve the most desirable effect. If the force is placed incisally, more tipping is evident on the target tooth. If the force is placed more gingivally, more bodily movement occurs. If the force is placed distally, movement about the mesial vertical axis occurs. If the force is placed mesially, movement about the distal vertical axis occurs.

PLACEMENT PROCEDURE

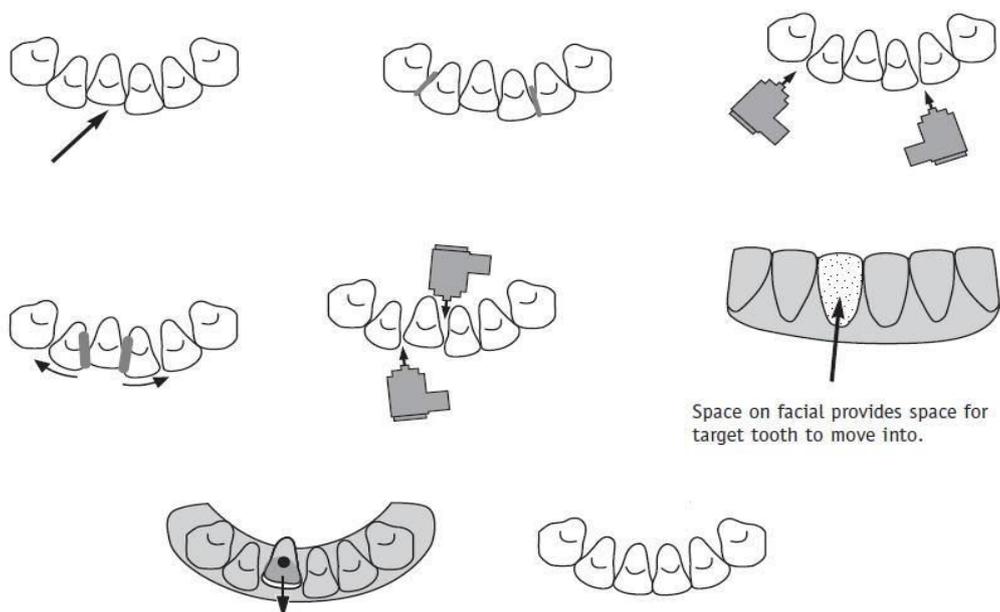
Acid-etch the enamel surface to which the composite will be bonded. The etched area should be no greater than 2-3mm in diameter; it is neither necessary nor advisable to etch the entire enamel surface. Place a 1mm-high mound of composite on the etched enamel surface. This is most efficiently done with a composite-loaded syringe. Any standard bonding composite will blend with the color of the enamel. The height of the composite mound can be measured with a Boley's gauge before and after curing.

If necessary, the mound can be quickly amplified by adding a layer of composite or reduced with a sandpaper disk. Insert the previously thermoformed Essix appliance in the mouth. It will press against the mound as it returns to its resting state, inducing tooth movement proportional to the height of the mound. If the patient feels pressure on the target tooth, the size of the mound is usually adequate.

If no pressure is felt, add a small amount of composite. At times, the patient may feel no pressure when the appliance is seated, but will experience a proprioceptive feeling of force after it has been in place for 30 seconds and then removed. This indicates that there is adequate force to effect tooth movement. On the other hand, if the force is so great that the appliance is difficult to seat, reduce the height of the mound with a sandpaper disk.

BIOMECHANICS WITH ESSIX SYSTEM

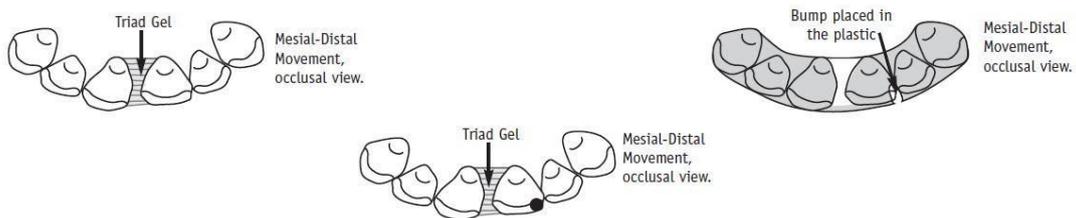
BODILY TOOTH MOVEMENT-



1. Insert separators one contact away from the blocked-out incisor
2. Use ARS to create space (0.5mm–1.0mm).
3. Use separators (slightly larger than in earlier Step) to move teeth into space created in previous step. Again, see the patient no more than 5 days after placement.

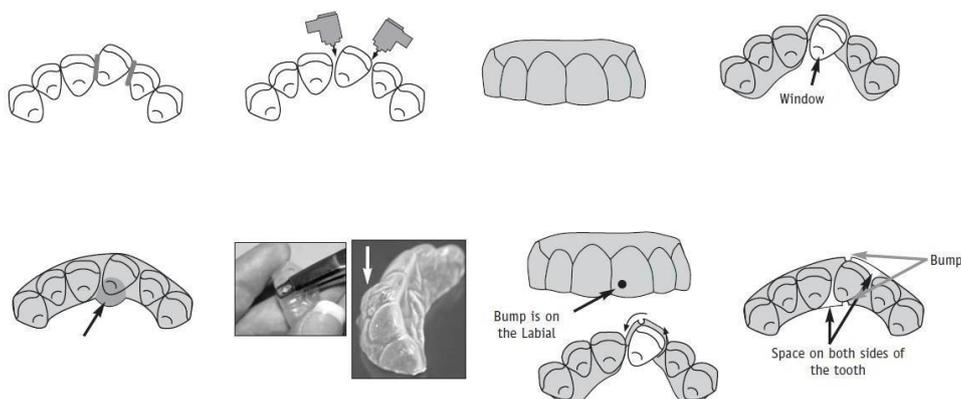
4. Use ARS to create additional space (0.5mm – 1.0mm) adjacent to the target tooth.
5. Construct an Essix appliance over the workingcast
6. Create a facial window (space within the appliance) for the tooth to move out of the blocked out position
7. Use Hilliard pliers to create force in 1mm increments to move the tooth into the facial window

□ □ SIO- DISTAL MOVEMENT



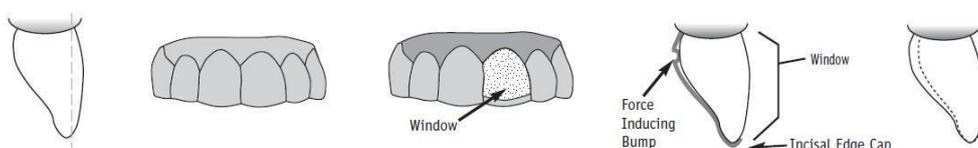
1. *Triad gel #30009* is placed on the working model on the side of the tooth the lateral movement is to occur on. This creates a space, like a channel, in the thermoplastic for the tooth to move into when a force is created on the opposite side.
2. The force for the desired movement is provided by either of the following methods:
 - A. A bump preparation in the plaster on the distal of the incisor.
 - B. A bump formed in the thermoplastic with the Mesial-Distal Thermopliers after the appliance has been fabricated.
3. The Bubble-Bump technique allows several teeth to be moved at the same time in the mesial distal direction

ROTATION



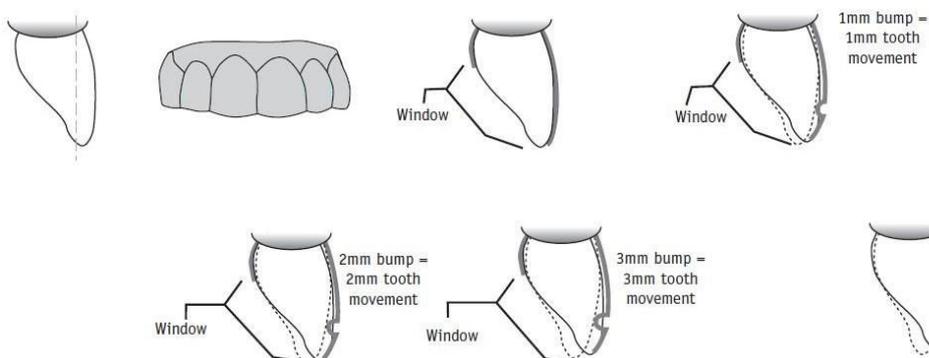
1. This technique utilizes the Micro-ramp Thermopliers #82560.
2. Insert separators on either side of the tooth to create an open field for interproximal reduction.
3. Use ARS to create additional space between teeth.
4. Use the *Bubble-forming Thermopliers #82590* to create a bump from the inside of the Essix appliance

TORQUEING



1. Construct an Essix appliance over the working cast.
2. Create space for the tooth to move leaving an incisal edgcap
3. Using the *Maxillary Pliers #82520*, place a 1mm bump near the gingival border. (For lower teeth, use the *Mandibular Pliers #82530*.) Use the *Micro-ramp Pliers #82560* to induce a bump close to the gingival margin if the *Maxillary* and *Mandibular Pliers* are too thick

TIPPING



1. Construct an Essix appliance over the workingcast.
2. Create space for the tooth tomove.
3. Make sure the incisal cap is also cut away, but the gingival contact point remains.
4. Using the *Maxillary Pliers #82520*, place a 1mm bump near the incisal edge. (For lower teeth, use the *Mandibular Pliers #82530*.) Use the *Micro-Ramp Pliers #82560* to induce a

bump close to incisal margin if the *Maxillary* and *Mandibular Pliers* are toothick.

5. Increase the depth of the original bump on subsequent visits for additional tooth movement

THE PROCESS BEHIND THE INVISALIGNS

The invisalign procedure includes several steps. Step one is the gaining of whole patient facts from the treating orthodontist. As soon as obtained at Santa Clara the records go through a series of steps from scanning to case setup and then returned to the clinician for a review referred to as Clincheck. The system of manipulating digital teeth movements is complete whilst the clinician approves the Clincheck. As soon as the clincheck is authorized, the aligners are processed and despatched to the clinician.

IMPRESSION MAKING FOR INVISALIGNS SILICONES:

Addition silicone materials are frequently called POLY VINYL SILOXANE impression materials. They are available as two pastes or putties (base and catalyst).

- The base paste – polymethyl hydrogen silicone other siloxane pre polymers hybrid silicone fillers.
- The catalyst paste – divinyl polydimethyl siloxane other siloxane prepolymers platinum salt activator Retarder fillers.

The addition reaction polymer is terminated with vinyl groups and is cross linked with hybrid groups activated by platinum salt catalyst. No reaction by-products develop as long as correct proportions of vinyl silicone and hybrid silicone are maintained and there are no impurities. However, secondary reaction between moisture and residual hybrid siloxane of the base polymer can lead to the development of hydrogen gas.

Although technically not a by-product, the hydrogen gas evolved from the set material can result in pinpoint voids in the gypsum casts that are poured soon after removing the impression from the mouth. Manufacturers often add a noble metal, such as platinum or palladium, to act as scavenger for the released hydrogen gas.

POLYETHERS:

Polyether elastomeric material was introduced in Germany in the late 1960s. It is available in light, medium and heavy consistencies. The polyether rubbers are supplied as two pastes,

- The base paste – the polyether polymer colloidal silica as filler plasticizer such as glycol ether or phthalate.

- The accelerator paste – alkyl-aromatic sulfonate filler plasticizer.

It is cured by a reaction between aziridine ring, which are at the end of branched polyether molecules. The main chain is a copolymer of ethylene oxide and tetrahydrofuran. Cross linking and setting is brought by an initiator, an aromatic sulfonate ester. This produces cross linking by the cationic polymerization via the imine end groups.

Mixing can be done by hand, using an auto mix gun with static mixing tip or by using benchtop dynamic mixer. There is no volatile by-product during polymerization of the polyether. Contamination with water can cause an expansion of the setting material and should be avoided.

ALGINATES:

Alginate impression materials can be mixed by hand or by mixing machine. Because alginates are hydrogels, they shrink on storage as a result of syneresis and evaporation. Disinfection can be accomplished by either spray or immersion.

SEVERAL TIPS MUST BE TAKEN TO ACHIEVE A QUALITY IMPRESSION

CRITERIA FOR GOOD IMPRESSION	TROUBLESHOOTING TIPS
Impression uniformly mixed	Make sure dispensing tips of automix cartridge are open.
Impression supported by tray	Make sure impression material is uniformly distributed in the tray. Extend the tray with wax if necessary.
No visible defects	Make sure there are no voids or tears.
Impression adheres to tray	Application of proper adhesive. Make sure the impression has not detached from the tray.

IMPRESSION TECHNIQUE

- One step technique (monophase): Medium viscosities of polyether and addition silicone are often used for the monophase or single viscosity technique. A part of material mixed is placed in the tray, and another portion is placed in the syringe.
- Double mix technique (tray/wash): A wash material is injected around the teeth using a syringe, and the tray filled with a heavy bodied material is placed.
- Two step technique (tray/ wash):A preliminary impression is made with the heavy bodied material with a cellophane spacer on top . Wash material is added after removal of spacer to the preliminary for the final impression. The best accuracy can be achieved by using a tray/wash technique.

ADVANTAGES

- Invisalign aligners are clear, comfortable and removable
- Aligners are removable. this allows patient to maintain their current oral hygiene practices. Patient can brush and floss normally.
- They are comfortable and do not cause irritation to the cheeks or surrounding tissues, as can happen with wires or brackets.
- Invisalign can be used with patients for whom conventional fixed appliances are contraindicated because of metal or nickel aligners.
- Invisalign treatment is unique in that treating clinician can specify to slow down movements programmed into each aligner in patients who have lower pain threshold.
- As the Invisalign appliance do not cover palate , it usually does not affect speech.

LIMITATIONS

- Primary limitation is compliance. Because the aligners are removable, the orthodontist must rely on the patient's motivation and dependability to achieve the desired results.
- All permanent teeth should be fully erupted for treatment using this appliance.
- There is currently no capability to incorporate basal orthopedic change with this appliance system.
- Major restorative work should be performed before the commencement of treatment.
- Only crown position is displayed on the computer program. Because the clinical appearance of crown inclination is not always predictive of root inclination, the potential exists for a virtual treatment to be approved.

SUMMARY

The invisalign appliance can be a treatment alternative for simple malocclusions, however it has a few obstacles. Attaining comparable effects to those of more conventional fixed appliances can be difficult. The usage of the invisalign appliance in combination with fixed appliances has been explored to reduce the time had to wear conventional fixed appliances, but can also bring about extensively higher expenses. Conversely, the invisalign appliance can provide an exceptional esthetic all through treatment, ease of use, comfort of wear, and superior oral hygiene. Additional research and refinement of the design have to allow further improvement of this worthwhile remedy.

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