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# An Aesthetic Orthodontic Treatment Option

## *Fabrication and Applications*



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Orthodontic treatment for adult patients has traditionally focused on being unnoticeable as well as minimizing disruption of the patient's lifestyle.<sup>1</sup> Lingual braces are a great option for those who want straight teeth and a beautiful smile without showing any braces during the orthodontic treatment process.<sup>2,3</sup> While lingual application clinical skills have been developed, this treatment may not be cost effective due to excessive chair time.

The development of Invisalign (Align Technology) made oral hygiene an easier task and has allowed the patient to go about a normal lifestyle without disruption.<sup>4</sup> It is particularly popular among adults who want to straighten their teeth without the unflattering look of traditional metal braces, which are commonly worn by children and adolescents. Another development in this area, the Clear Aligner [Author: manufacturer?], can also move the teeth

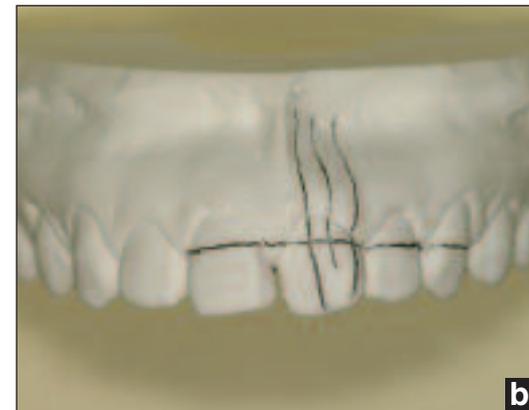


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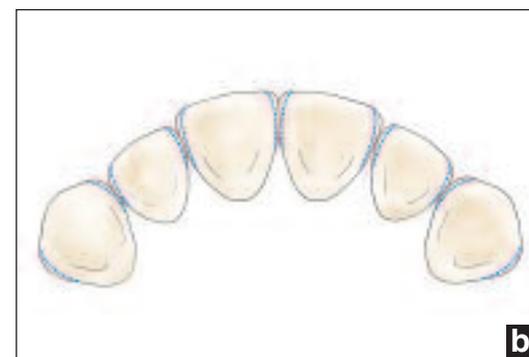
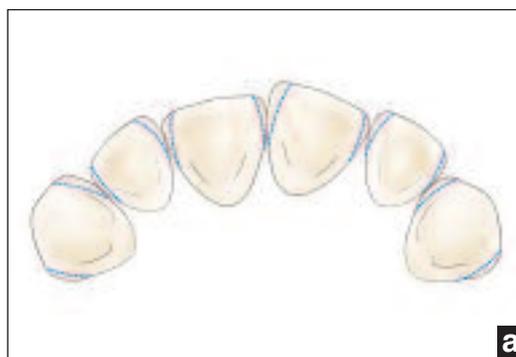
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easily without braces. Because it is transparent and removable, patients of all ages can use it, especially if they want an aesthetic orthodontic treatment option. The Clear Aligner differs from Invisalign, which provides serial aligners.<sup>5-7</sup> Clear Aligner is an efficient orthodontic appliance that is produced periodically.<sup>5</sup> It can be fabricated easily by either the orthodontist or general dentist in a cost-effective manner.

To fabricate a Clear Aligner, at intervals of every 3 or 6 weeks impressions are taken for working casts, which are used with 2 or 3 different plastic sheets (Duran [Scheu Dental]) and a pressure molding machine (Biostar [Scheu Dental]) or a vacuum forming machine (DENTSPLY Raintree Essix).<sup>8-10</sup> Different plastic sheets are thermoformed on the set-up model made for tooth move-



Figures 1a and 1b. Reference lines: lingual view (a), labial view (b).



Figures 2a and 2b. The interproximal reduction (IPR) of a contact point between rotated teeth will often be compromised (a). If rotations are corrected prior to the IPR, the contact point will be more physiologic when space is eventually closed (b).

ment using a vacuum former. The tooth movement is very efficient, while the patient remains fairly comfortable. The Clear Aligner comes in 2 different thicknesses of plastic sheets, 0.020" and 0.030"; or 3 different thicknesses of plastic sheets, 0.020", 0.025", and 0.030".

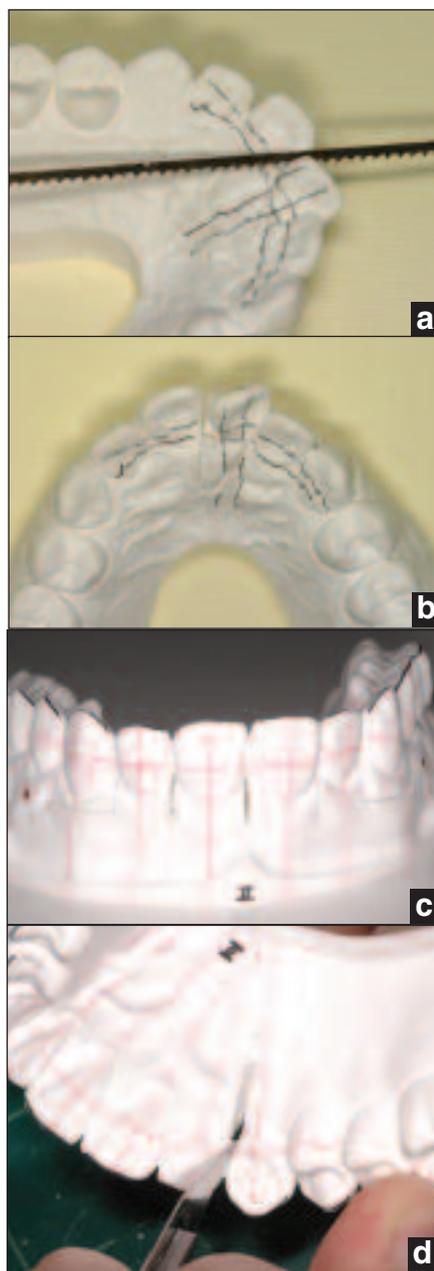
**[AUTHORS: Is the previous sentence correct? Are these two different packages/fabrication kits that can be ordered for use? Perhaps it would be less confusing to the readers, to whom this technique/product is being newly introduced, to simply say it can be fabricated using 0.020", 0.025", and 0.030"?]**

In fixed orthodontic treatment, a lighter flexible wire is engaged as an initial wire and changed to a heavier rigid wire as treatment progresses. For aligners, in the first

week, a 0.020-inch-thick Clear Aligner is used for a week and then changed to a 0.030-inch-thick aligner for 2 weeks. During the 3 weeks of treatment, plastic sheet aligners of different thicknesses can be used, depending upon the mechanics. The clinician can adjust the exchange period of aligners by observing tooth movement and monitoring patient comfort. By using different thicknesses of aligners, a patient's pain can be reduced and the transparency of the aligner is improved by reducing the gap between the Clear Aligner and the teeth.

Since the aligner is fabricated from the working cast in each visit, it is readily available to change the treatment plan throughout the course of the treatment if the desired tooth movement is not achieved. It also enables the patient to receive any nec-

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**Figures 3a to 3d.** Sawing on the target tooth (a). Separation of upper left central incisor (b). Labial, lingual cervical area, and the base of apical area is cut using a bur (c). Contact point incision using a lab knife (d). [Author: looks like RIGHT incisor. Please review.]

essary dental treatments with ease during the treatment as needed. The treatment can also be easily resumed even if the patient has not worn the aligners for a period of time.

#### LABORATORY PROCEDURES

**Drawing the reference line.** To measure the tooth movement, a reference line is drawn on the cast. This line verifies the movement of the teeth. Vertical and horizontal reference lines are drawn on the teeth and extended to the gingiva. In order to locate the teeth easily after they are separated, horizontal reference lines are extended to the adjacent, noninvolved teeth (Figures 1a and 1b).

**Sawing.** Using the 0.25-mm Pindex handsaw (Coltène/Whaledent), the target tooth can be removed from the work-

ing cast. When the target tooth is separated from the working cast, be careful not to damage the tooth surfaces. The interproximal reduction (IPR) should be postponed until after alignment to preserve proximal contour. If the IPR was done before alignment, the contact point will be irregular, which will decrease long-term stability (Figures 2a and 2b). If the IPR was done between the teeth, the saw can be used to divide the tooth (Figures 3a and 3b). However, if interproximal reduction is not necessary, or arch expansion is needed, it is advisable not to use the saw. In this case, first use the No. 701 tapered fissure bur (Henry Schein) to cut the labial, linguocervical area and the base of the apical area without involving the contact points (Figure 3c).

Then, using a lab knife with a stainless steel surgical blade No. 25 (Henry Schein), slight labial and lingual contact point incisions are used to ease the separation of the teeth with a finger force similar to splitting a table cracker into 2 pieces (Figure 3d). With the 0.25-mm-thick saw, approximately a 0.4-mm gap should be expected on the model.<sup>8-10</sup> If this gap is closed during the model set-up for the patient who has spacing, the amount of gap will be expressed as an orthodontic force (Figures 4a to 4c).

**Realignment.** The target tooth is set up so that it can be moved to the desired position on the working cast. This process is referred to as *realignment*. First, remove the excess base of the target tooth, which hinders the movement of the tooth. The separated target tooth is fixed using baseplate wax after measuring the horizontal and vertical distances to the ideal position. After comparing the previous model, if the realigned position is ideal, block-out resin is used for fixation. Do not use wax after cast modification, because the heat generated when thermoforming the plastic will melt it.<sup>11</sup> To withstand the pressure of the vacuum former during thermoforming, blue-opaque block-out (composite) putty (Blue Blokker [Scheu Dental]) should be applied and properly light-cured. By overfilling this putty, it is easy to reduce and polish a certain amount of the composite to increase surface smoothness. It reduces the patient's discomfort by decreasing the pressure to the gingiva as well.

In order to compare the tooth movement with the previous model, a Bernklau Gauge (Dentaurum) can be used. However, to measure the accurate amount of tooth movement, the aligner aid program (AAP; IV-

Tech) is recommended. [Author: what is IV-Tech?] The movement of one tooth can easily be measured by eyesight; however, if more than one tooth is involved, the AAP combined with photos taken with a digital camera could be used to measure the movement accurately. Before fabricating the set-up model, the initial working cast photo is taken using a digital camera. After the target tooth is moved to the desired position, it is fixed in place by baseplate wax or Blue Blokker, and a digital photo is then retaken. Set-up changes can be exactly measured and verified by overlaying the digital photos. This computer-compatible program measures distance and angles of teeth movements on the set-up models (Figures 5a to 5c).

**Clear Aligner trimming.** After the aligner has been molded, it is removed from the working cast using curved Mayo scissors (Robbins Instruments) or a wheel saw (DENTSPLY Raintree Essix). Be careful not to deform the aligner during the removal procedure. Trim the borders of the aligner to extend 3.0 to 4.0 mm onto the facial and linguogingival surfaces, with the exception of trimming the lingual of the lower incisor area as far gingivally as possible, usually about 5.0 mm. This modification will reduce "tongue awareness" of the lingual border of the appliance.<sup>12</sup> Cut away the plastic at the buccal-distolingual line angle of the terminal molar. This modification establishes a fingernail purchase for the patient to facilitate removal of the appliance (Figure 6). [Author: is above sentence correct?] The overall margin of the Clear Aligner should be rounded to reduce patient discomfort. Ultrasonic cleansing and 75% ethanol is recommended for sterilization, and is stored in the sterilization pack.

**Delivery of the appliance.** First, different plastic sheets and upper/lower aligners should be separated and marked to avoid any possible mix-up. Initially, the posterior part of the aligner is engaged, and then the anterior part is slowly engaged. Be careful not to fold the posterior area over when the posterior part is inserted. Patients may notice that the appliance feels tight when it is initially seated. This is due in part to the fact that the aligner was fabricated at room temperature and expands slightly when it is exposed to intraoral temperatures.

To relieve a tight aligner, cut off the tips of the excessive interproximal indentations on the inside of the appliance with a scalpel.<sup>12</sup> When the appliance is too loose, Clear Aligner



**Figures 4a to 4c.** The patient is missing 2 mandibular anterior teeth. Pretreatment (a), and post-treatment (c) intraoral occlusal view of the closed lower anterior area after sawing on the working cast (b).

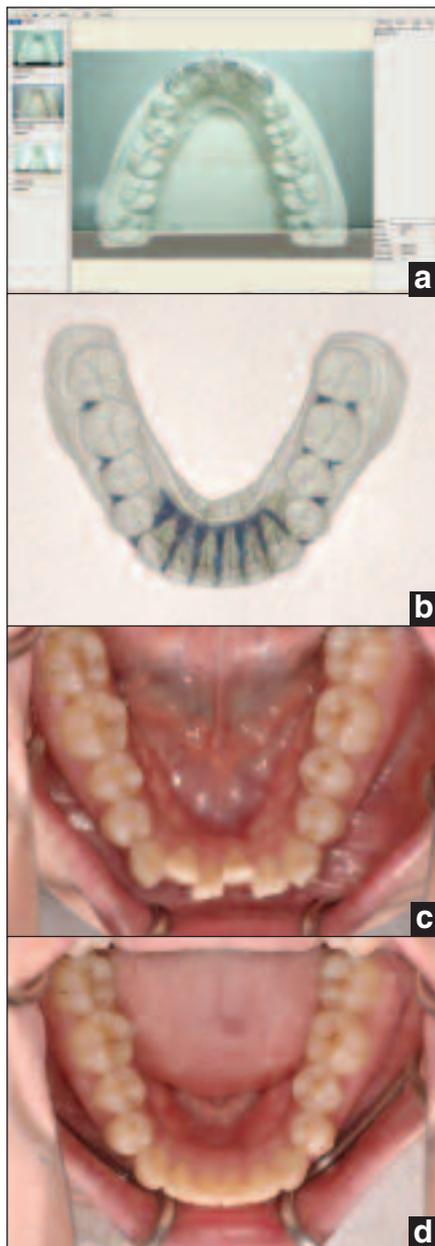
pliers (IV-Tech) can be used to increase the retention of an aligner by accentuating the retentive undercuts gingival to contact points.<sup>13</sup> Once the aligner is in the proper position in the mouth, ask the patient to chew lightly. If the patient complains of discomfort at this time, the aligner should be removed immediately and checked for the amount of tooth movement on the set-up model. If the discomfort is the result of excessive movement, then the aligner should be remade. If it is a minor discomfort, then it will disappear within 24 hours. In some instances, the appliance may impinge on faciogingival tissues, blanching them. This usually occurs at the gingival border on the labial aspect of the appliance. When a blanching of the tissue is apparent, reduce the superior-facial contour of the plastic to no more than 1.0 mm onto the faciogingival rather than the conventional 3.0 to 4.0 mm.<sup>12</sup>

The aligner should be worn at least 17 hours per day, including the patient's time during sleep.<sup>8-10</sup> Instruct the patient to clench into the appliance periodically until it seats comfortably. The masticatory action increases orthodontic force and decreases any friction between

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**Figures 5a to 5d.** Aligner aid program showing the information of teeth movement (a). Final set-up model after 6 aligners (b). Pretreatment (c) and post-treatment (d) intraoral occlusal view of the lower anterior dentition after crowding control using the Clear Aligners.

the Clear Aligner and the teeth. Patient cooperation is essential for successful results, especially in cases where intrusive forces are applied. The base of intrusion area is removed from the working cast, and a new set-up model is fabricated for the intrusion Clear Aligner. Chewing exercise prevents the extrusion of posterior dentition, which results in the intrusion of the anterior dentition (Figures 7a to 7c).

## DISCUSSION

As with other conventional orthodontic appliances, the Clear Aligner is another type of orthodontic appliance that needs proper diagnosis and treatment planning prior to its fabrication. To establish a treatment plan, a panoramic radiograph, a cephalometric radiograph, and study

models are all required. The panoramic radiograph will allow visualization of the root configuration, root axis, and alveolar bone status. The assessment of the skeletal pattern and tooth angulations can be obtained by using the cephalometric radiograph. The information of tooth angulations (ie, upper incisor to SN and IMPA) can be converted to the set-up model using the Clear Aligner model checker.<sup>8-10</sup> Accordingly, it is possible to determine ideal torque and angulation of the anterior dentition during set-up model fabrication. Along with good maxillary and mandibular study models, a vinyl polysiloxane bite registration is recommended to replicate the patient's occlusion properly.<sup>4</sup> Periapical radiographs that show enamel thickness are also useful in estimating the amount of interproximal reduction needed to resolve crowding. The Bolton discrepancy is critical in deciding the IPR or the resin buildup on either excessive or deficient maxillary and/or mandibular teeth.<sup>14, 15</sup>

When the Clear Aligner is used for the tooth movement, it is recommended not to mix certain types of movement. For example, it is not recommended to do the expansion and rotation of the tooth movement together. In this case, an excessive amount of orthodontic force is applied and extrusive forces will develop. Either after space gaining or arch expansion, alignment should be followed. It should always be remembered that heavy intermittent force could be applied to the teeth.

A set-up model, which is fabricated before treatment, will help a patient understand the treatment process as well as the dynamics involved. The aligner aid program provides a monitoring screen to compare the pretreatment working cast with the final set-up model. In addition, this program allows the dentist to predict how many Clear Aligners will be necessary to complete the treatment.

## CONCLUSION

The authors have found that indications for the potential applications of the Clear Aligner are extensive. It can be used for the correction of crowding, space closure, expansion and/or constriction, intrusion and/or extrusion, relapsed cases, interdisciplinary treatment cases, and active and/or passive retainers. Combined treatment with traditional fixed appliances before or after the Clear Aligner application increases the efficiency of the treatment and reduces the treatment time with fixed appliances alone. Because the

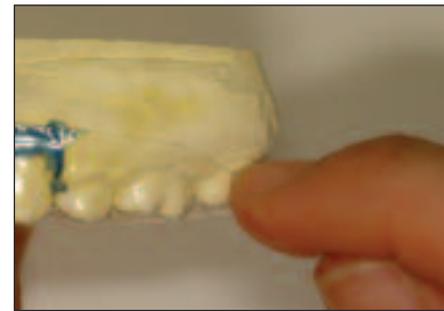
Clear Aligner can be used for minor tooth movement, the treatment plan is based on the patient's chief complaints. If the patient wears the aligner for a certain amount of time, the tooth movement is very fast and efficient since the aligner contacts the whole tooth surface. The Clear Aligner could be considered as an alternative for those who are reluctant to utilize conventional fixed appliances for orthodontic treatment.

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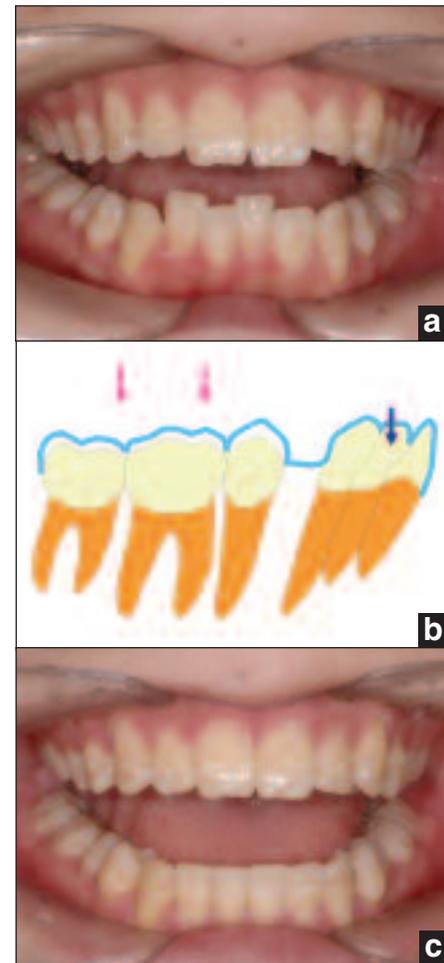
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**Figure 6.** Posterior notch formed on the buccal-distolingual margin of the terminal molar.



**Figures 7a to 7c.** Intraoral frontal view (patient in Figure 5) before (a) and after (c) treatment with the Clear Aligner (b), showing the intrusion of the mandibular anterior dentition.

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