

Orthodontic Treatment with Clear Aligners

Sharath Kumar Shetty¹, Cecilia Wilson^{2*}, Mahesh Kumar Y³, Vijayananda K. Madhur⁴

¹Professor & HOD, Department of Orthodontics and Dentofacial Orthopaedics, K. V. G. Dental College and Hospital, Sullia, Karnataka, India

²Post Graduate Student, Department of Orthodontics and Dentofacial Orthopaedics, K. V. G. Dental College and Hospital, Sullia, Karnataka, India

³Professor, Department of Orthodontics and Dentofacial Orthopaedics, K. V. G. Dental College and Hospital, Sullia, Karnataka, India

⁴Reader, Department of Orthodontics and Dentofacial Orthopaedics, K. V. G. Dental College and Hospital, Sullia, Karnataka, India

DOI: [10.36347/sjds.2021.v08i07.008](https://doi.org/10.36347/sjds.2021.v08i07.008)

| Received: 26.06.2021 | Accepted: 01.08.2021 | Published: 13.08.2021

*Corresponding author: Cecilia Wilson

Abstract

Review Article

The paradigm shift in orthodontics arrived with the introduction of Aligner System. It allows both dental practitioner and patient to develop a visual understanding of orthodontic tooth movement. The esthetic and practical advantages of the system have extended orthodontic services to a greater population. The transparency of the clear aligners enhances its esthetic appeal for those adult patients who are averse to wearing conventional labial fixed orthodontic appliances. Although guidelines about the types of malocclusions that this technique can treat exist, few clinical studies have assessed the effectiveness of the appliance.

Keywords: Orthodontic, aligners, tooth movement, esthetic.

Copyright © 2021 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

The paradigm shift in orthodontics arrived with the introduction of Aligner System. It allows both dental practitioner and patient to develop a visual understanding of orthodontic tooth movement. The esthetic and practical advantages of the system have extended orthodontic services to a greater population.

Prior to 1998, orthodontic clear aligner treatment was predominantly for very minor tooth movement, usually at the end of orthodontic treatment or to treat minor alignment relapse. In 1998, Align Technology, Inc. introduced Invisalign® to the orthodontic market. It used computerized 3D technology to visualize and move the teeth in a virtual model. This technology along with advances in 3D printing and manufacturing efficiencies allowed aligners to be produced in a large numbers and in a timely fashion. Initial cases were mild crowding or spacing [1] which progressed to cases that needed expansion and/or classification correction [2].

The available literature for aligner treatment has grown over the years with several clinical trials

being done that examine how well the predicted outcomes compare with the actual outcomes [3-5].

Treatment with clear aligners [6]

Regardless of the aligner system chosen, the practitioner should dictate the treatment plan which results in how the aligner treatment proceeds and where the teeth are to be moved. This is true if aligners are fabricated from a series of models where the teeth have been manually manipulated or from digital models in which the teeth are manipulated by computer or technicians. The following techniques can be used with most aligner systems, unless specifically noted, to treat the following orthodontic problems.

Openbite

Anterior openbite can be corrected either by intrusion of posterior teeth, or by extrusion of anterior teeth or by the combination of both. The Orthodontist makes the decision.

Extrusion of anterior teeth can be accomplished with attachments [7-9]. Attachment shape and location have been shown to affect retention of aligners [10, 11] Hennessy [12] wrote a recent article describing the optimized attachments developed for use

with Invisalign® including those for extrusion of anterior teeth which are pre-activated bevelled attachments. Even with extrusion of anterior teeth, an advantage of using aligners for treatment is the posterior intrusive affect that the aligners will have on the posterior teeth which also facilitates closure of the anterior openbite [7]. This posterior intrusive affect is beneficial in treating cases with crowding and minimal overbite. With fixed appliances, posterior arch expansion may tip the molars or premolars with equal ease. This tipping results in extrusion of the lingual cusp. In turn, the anterior openbite is made worse. Also with fixed appliances, if crowding is resolved with incisor proclination, the outcome of this tipping is a relative intrusion of the teeth again making the openbite worse [6].

Extrusion of anterior teeth with attachments and intrusion of posterior teeth with the aligner could take an extended amount of time depending on the amount necessary or may need either a greater force (particularly for posterior intrusion). In these instances, TADs have been used to facilitate both types of movements [13, 14].

Deepbite [6]

Deepbites are generally treated by anterior intrusion which can be difficult with aligners. To facilitate this movement, Invisalign® uses attachments on the premolars for anchorage while an active intrusive force is placed on the incisors as well as bite ramps built into the lingual of the aligner of the upper anterior teeth that act as a bite plane. Incisor intrusion can be difficult with aligners or take a protracted amount of time and no data exists on the effectiveness of these auxiliaries. In these instances, intrusion can be facilitated with TADs. Bowman [13] shows a very nice method to intrude upper incisors by creating a dimpled extrusion of the buccal surface of the aligner with a Hilliard plier (Dentsply Raintree Essix Glenroe, Sarasota, FL) and then cutting a notch. Vertical elastics are then used from the notched aligner to TADs placed in the anterior buccal vestibule to provide the intrusive force.

Space Closure

Aligners present a unique challenge because the goal is to move the teeth with pure translation in order to prevent the tipping from occurring in the first place because a tipped tooth is difficult to correct and can take a prolonged time to upright with aligners alone. As a result, when using aligners, methods to address this issue include aligners in combination with fixed appliances [2], auxiliaries placed on the tooth to change the point of force application [15, 16].

TADs to eliminate unnecessary forces on anchorage [15, 17] and attachments [7, 16, 18] to accomplish this movement TADs have been used as anchorage to avoid placing forces on teeth that could cause unnecessary tipping as described by Bowman

[17]. Choi [15] describes a unique method using a segmental aligner for the anterior teeth and using TADs to retract this segment. While no clinical trials have been done, case studies have shown that large attachments placed on the teeth to be moved may help prevent tipping [7, 16]. Samoto and Vlaskalic recently published treatment of an extraction case treated using Invisalign® and used knowledge of the biologic tooth movement cycle to control tooth movement and tipping by sequencing which teeth were moving at any particular time and altering the aligner wear time [18]. Preferably, attachments could be designed to help control the tooth movement or the anchorage segments. Womack [16] and Boyd [7] have demonstrated that vertical or horizontal attachments as shown in on the molars, premolars, or canines can help. Recently, Invisalign® developed attachments to control posterior anchorage in cases requiring extraction and retraction of anterior teeth. These strategies work by placing a force that creates a moment in the opposite direction to counter the tipping moment.

Crossbites [6]

Difficulty in the correction of crossbites is a factor of location in the mouth and the depth of the bite. Minor anterior or posterior crossbites with a bite depth up to about 10% are usually not difficult to treat with just the usual aligner treatment. Anterior or posterior crossbites with a bite depth greater than approximately 10% usually requires some other considerations to open the vertical to allow the tooth in crossbite to clear the opposing teeth such as anterior bite ramps that are available on the Invisalign® aligners or placing cold-cure acrylic on the occlusal surface of the aligners while the crossbite is being jumped.

Extrusion/Settling [6]

Often a ClinCheck for Invisalign will require the teeth to extrude into the final desired occlusion. While attachments are automatically placed to facilitate this movement when a threshold of greater than 0.4mm is reached, movements less than this are expected to occur unaided. Frequently, this does not occur and gingival beveled attachments can manually be placed on the desired teeth in the Clin Check. As another option, vertical elastics from buttons can also be used to facilitate this movement independent of the magnitude of the movement.

Class II Correction

Treatment options range from distalization of the upper dentition to protraction of the lower dentition or a combination of both. In younger patients, mandibular growth can also help in the correction of the Class II malocclusion. Fischer [19] presented several cases where he used attachments on molars and premolars to sequentially distalize the maxillary dentition to a Class I without the use of Class II elastics. In one of the cases, 2nd molars were extracted to facilitate the distalization. As in space closure, pure

translation during distalization can be difficult with aligners or fixed appliances. Often the posterior teeth are tipped back and care must be taken to then, distalize the root and preventing the crown from elapsing and tipping forward. This movement can be difficult with aligners due to force necessary to create the moment that will distalize the root. In addition, anchorage for the distalization comes from the anterior teeth and flaring or anterior movement may occur. This is usually controlled by using the lower arch for anchorage with Class II elastics which can then also assist in distalizing the upper dentition [20] as well as protracting the lower dentition. As with space closure, TADs placed either in the buccal or the palate can be used as anchorage to distalize the upper dentition to Class I or to retract the anterior teeth after extraction of upper first premolars [17]. Both the Carriere Distalizer [20, 21] and the Mara [22] appliance have been used to initially create a class I molar followed by treatment with aligners to finish the case. Arreghini *et al.* [23] described treating a patient with a Runner which is a series of aligners with ramps build on the occlusal surfaces that resemble Twin Block and are meant to advance the mandible and mandibular dentition. This works well in growing children to take advantage of growth in correcting the Class II malocclusion.

Class III

Treatment approach to Class III malocclusions with aligners is similar to those with fixed appliances. Class III elastics and either maintaining dental compensations or creating dental compensations are often done when a Class III malocclusion is treated by orthodontics only. When surgery is a consideration, the case is decompensated prior to surgery. TADs have been used to distalize the lower dentition in an effort to minimize some compensation, but this approach has its limits and may not fully correct the Class III malocclusion [24].

CONCLUSIONS

Clear aligner treatment has developed from a technique of only treating mild crowding or spacing of anterior teeth to a technique that can be used to treat almost any type of orthodontic problem. Aligner materials and attachments will continue to improve which will allow aligners to fit better and for longer periods of time and result in better outcomes. Though invisalign provide better esthetics and comfort during the treatment when compared to fixed orthodontic treatment, it requires strict patient's compliance and have certain limitations. Additional research and refinement of the design should allow further development of this worthwhile treatment.

REFERENCES

1. Boyd, R. L., Miller, R. J., & Vlaskalic, V. (2000). The Invisalign system in adult orthodontics: mild crowding and space closure cases. *Journal of Clinical Orthodontics*, 34(4), 203-212.
2. Boyd, R. L., & Waskalic, V. (2001, December). Three-dimensional diagnosis and orthodontic treatment of complex malocclusions with the invisalign appliance. In *Seminars in orthodontics* (Vol. 7, No. 4, pp. 274-293). WB Saunders.
3. Buschang, P. H., Ross, M., Shaw, S. G., Crosby, D., & Campbell, P. M. (2015). Predicted and actual end-of-treatment occlusion produced with aligner therapy. *The Angle Orthodontist*, 85(5), 723-727.
4. Kravitz, N. D., Kusnoto, B., BeGole, E., Obrez, A., & Agran, B. (2009). How well does Invisalign work? A prospective clinical study evaluating the efficacy of tooth movement with Invisalign. *American Journal of Orthodontics and Dentofacial Orthopedics*, 135(1), 27-35.
5. Krieger, E., Seiferth, J., Marinello, I., Jung, B. A., Wriedt, S., Jacobs, C., & Wehrbein, H. (2012). Invisalign® treatment in the anterior region. *Journal of Orofacial Orthopedics/Fortschritte der Kieferorthopädie*, 73(5), 365-376.
6. Wheeler, T. T. (2017). Orthodontic clear aligner treatment. *Seminars in Orthodontics*, 23(1), 83-89. doi:10.1053/j.sodo.2016.10.009.
7. Boyd, R. L. (2007). Complex orthodontic treatment using a new protocol for the Invisalign appliance. *Journal of clinical orthodontics: JCO*, 41(9), 525-523.
8. Guarneri, M. P., Oliverio, T., Silvestre, I., Lombardo, L., & Siciliani, G. (2013). Open bite treatment using clear aligners. *The Angle Orthodontist*, 83(5), 913-919.
9. Schupp, W., Haubrich, J., & Neumann, I. (2010). Treatment of anterior open bite with the Invisalign system. *J Clin Orthod*, 44(8), 501-7.
10. Dasy, H., Dasy, A., Asatrian, G., Rózsa, N., Lee, H. F., & Kwak, J. H. (2015). Effects of variable attachment shapes and aligner material on aligner retention. *The Angle Orthodontist*, 85(6), 934-940.
11. Jones, M. L., Mah, J., & O'Toole, B. J. (2009). Retention of thermoformed aligners with attachments of various shapes and positions. *Journal of clinical orthodontics: JCO*, 43(2), 113-117.
12. Hennessy, J., & Al-Awadhi, E. A. (2016). Clear aligner's generations and orthodontic tooth movement. *Journal of orthodontics*, 43(1), 68-76.
13. Bowman, S. J., Celenza, F., Sparaga, J., Papadopoulos, M., Ojima, K., & Lin, J. C. Y. (2015). Creative adjuncts for clear aligners. *J Clin Orthod*, 49(2), 3.
14. Giancotti, A., Germano, F., Muzzi, F., & Greco, M. (2014). A miniscrew-supported intrusion auxiliary for open-bite treatment with Invisalign.
15. Choi, N. C., Park, Y. C., Jo, Y. M., & Lee, K. J. (2009). Combined use of miniscrews and clear appliances for the treatment of bialveolar protrusion without conventional

- brackets. American journal of orthodontics and dentofacial orthopedics, 135(5), 671-681.
16. Womack, W. R. (2006). Four-premolar extraction treatment with Invisalign. *Journal of clinical orthodontics: JCO*, 40(8), 493-500.
 17. Bowman, S. J., Celenza, F., Sparaga, J., Papadopoulos, M., Ojima, K., & Lin, J. C. Y. (2015). Creative adjuncts for clear aligners. *J Clin Orthod*, 49(2), 3.
 18. Samoto, H., & Vlaskalic, V. (2014). A customized staging procedure to improve the predictability of space closure with sequential aligners. *Journal of clinical orthodontics: JCO*, 48(6), 359-367.
 19. Fischer, K. (2010). Invisalign treatment of dental Class II malocclusions without auxiliaries. *Journal of clinical orthodontics: JCO*, 44(11), 665-72.
 20. Schupp, W., Haubrich, J., & Neumann, I. (2010). Class II correction with the Invisalign system. *J Clin Orthod*, 44(1), 28-35.
 21. Rodríguez, H. L. (2012). Nonextraction treatment of a class II open bite in an adult patient.
 22. Eckhart, J. (2009). Sequential MARA Invisalign Treatment. *J Clin Orthod*, XLIII:439-448.
 23. Arreghini, A., Carletti, I., Ceccarelli, M. C., Lombardo, L., & Siciliani, G. (2014). Class II treatment with the Runner in adolescent patients: Combining Twin Block efficiency with aligner aesthetics. *Journal of the World Federation of Orthodontists*, 3(2), e71-e79.
 24. Lin, J. C., Tsai, S. J., Liou, E. J., & Bowman, S. J. (2014). Treatment of challenging malocclusions with Invisalign and miniscrew anchorage. *Journal of clinical orthodontics: JCO*, 48(1), 23-36.