Clear Aligner Therapy

and the

Orthodontic-Restorative Interface

by Jeffrey R. Briney, DDS

Single Crown Restoration
After Trauma

Christopher Hooper, DDS
Clear Aligner Therapy and the Orthodontic-Restorative Interface

ABSTRACT

Clear aligner therapy improves esthetics during orthodontic care in comparison to fixed orthodontic appliances and standard removable appliances. In part due to this, the number of adults seeking orthodontic treatment has increased, and clear aligner therapy is now frequently performed on adults and adolescents. The availability of auxiliaries/composite attachments has also improved the level of control and types of tooth movements that can be attained using clear aligners. In addition, there is less risk of gingivitis, caries, and oral irritations with clear aligner therapy than is associated with fixed orthodontic appliance therapy. Clear aligner therapy involves a digital workflow for treatment planning, and is also used to enhance restorative care by providing for space/repositioning teeth to improve potential results and/or minimize the invasiveness or extent of restorative care required to achieve the desired result, and may also reduce the duration of treatment.

EDUCATIONAL OBJECTIVES

The overall goal of this course is to provide information on clear aligner therapy and its application in enhancing restorative outcomes and treating crowding. After completing this article, the reader will be able to:

1. Describe the types of movements that can be achieved using clear aligners.
2. Review the digital workflow for clear aligner therapy.
3. Define the role of auxiliaries and describe how these are used for clear aligner therapy.
4. Delineate the potential benefits of clear aligner therapy for patients, including those requiring restorative care.

ORTHODONTIC TREATMENT OPTIONS INCLUDE FIXED orthodontic appliances (FOA), traditional removable appliances, and clear aligners. The genesis of clear aligners began in 1944 with the use of thermoplastic full tooth-coverage appliances to obtain tooth movement. FOA continue to be the most frequent method of treatment. More adults are seeking orthodontic treatment, and the number and proportion of cases treated with clear aligners has steadily increased over the past two decades. This can be attributed to the perceived importance of esthetics and the availability of clear aligners, which have improved patient comfort and esthetics during orthodontic treatment. Clear aligner systems are available direct-to-consumer without dentist/orthodontist supervision. The focus of this article is on clear aligners that are supervised by dentists and orthodontists, and designed to deliver results for simple and complex cases while maintaining oral health.

ABOUT THE AUTHOR

Jeffrey R. Briney, DDS – Dr. Briney is an award-winning graduate of Indiana University and has a 20-year history of private practices in Dana Point and Laguna Beach, CA, which have been featured in many dental publications. He is currently establishing a collection of practices in Dubai, which will debut in late 2018. He speaks regularly around the world with regard to his personal approach to Surgical, Laser & Restorative Dentistry, complemented with Facial Esthetics & Orthodontics. Dr. Briney also writes for several publications ranging from techniques utilized in his personal cases to evaluating many dental products that are new to our dental field. He currently teaches around the world for Biolase, Coltene, ClearCorrect, Straumann, and Suni Imaging. Dr. Briney teaches live webinars for cerecdorctors.com. His passion in dentistry is centered around his mission work in Haiti. Dr. Briney can be reached at drbriney@gmail.com or through his website at www.drbriney.com.
Clear Aligner Therapy

Clear aligner therapy has transformed orthodontic treatment. While initially used with some success for simple cases, sequential series of clear aligners are now used to treat anterior crowding; midline discrepancies; Class I, II, and III malocclusions; and to open and close spaces. Tooth movements performed include tipping, rotation/derotation, torquing, intrusion, extrusion, and anterior-posterior translation. The combination of planned tooth movements will result in planned arch changes, whether distalization, mesialization, lingualization, or arch expansion.

Digital Workflow

Computer-aided design/computer-aided manufacturing (CAD/CAM) is integral to clear aligner systems. Digital scans are taken of both arches as well as digital images (photographs) of the patient’s dentition, which typically includes front views, left and right lateral views, upper and lower occlusal views, profile, and full-face “smiling” and “not smiling” images. Intraoral images should be taken using cheek retractors and for the occlusal views also using intraoral mirrors. The scans and images are then uploaded in minutes to a designated site, where the digital models and treatment plan setup are designed. With some systems, conventional impressions can be taken instead of digital scans and sent to a designated location to be scanned. Intraoral scans are easier for patients and the clinician/assistant, and digital models are at least as or more accurate and reliable for measurements made during treatment planning compared to traditional models. The treatment plan set-up, projected tooth movements and series of aligners are then reviewed by the dentist/orthodontist and patient. After acceptance, 3D-printed models are created and the aligners fabricated. The series of aligners is then sent to the office. Should extensive tooth movement be required, interim scans can be planned and taken partway through treatment and the workflow repeated for the subsequent aligners required to complete treatment. When looking at clear aligner systems, considerations include compatibility with browsers, devices, and whether and which types of digital scans may be submitted. Other considerations include the ability to adapt treatment plans, and the overall support provided by the company.

Auxiliaries

Auxiliaries include resin engagers/buttons/attachments that are bonded to selected teeth. In addition, expanders can be used to effect expansion of space between teeth. Auxiliaries allow for more difficult tooth movement than would be otherwise possible, provide greater control over tooth movement, and/or are used to improve aligner retention. The need for, and type of, auxiliaries is typically determined chairside and then treatment-planned in the setup. Depending on the system, pressure points within aligners can also be used to generate force. Engagers can be used to attach elastics for traction to distalize upper posterior teeth when treating Class II cases, or the elastics can be attached to slits/cutouts in the aligner. Temporary anchorage

Figure 1—Digital workflow for clear aligners
devices (TADs) can also be combined with clear aligner use to control and achieve planned tooth movement.\(^9\)

**Interproximal Reduction**

Interproximal reduction (IPR) can be performed to create a small or moderate amount of additional space if needed, by removing proximal enamel prior to taking digital scans and images.\(^9,10\) This may avoid orthodontic extractions, which are more invasive. IPR can be performed manually (using interproximal strips or hand discs) or mechanically (using diamonds or carbides in a handpiece), and care must be taken to avoid removing too much enamel, miscontouring teeth, or damaging soft tissues.

**The Orthodontic–Restorative Interface**

Orthodontic treatment with clear aligners provides opportunities to enhance restorative care and allows treatment that would otherwise not be possible, take longer, be more invasive, or result in less desirable results. Examples of the application of clear aligner therapy prior to restorative care include creating space for restorations, closing spaces, derotating anterior teeth so that they can be restored without esthetic or functional compromises, and adjusting the position of teeth to enhance the planned final restorative outcome. Since clear aligners are intended to be worn all day and night except when eating or performing oral hygiene, and are removable appliances, the patient’s level of commitment and anticipated compliance with aligner use must be assessed prior to embarking on treatment. The two cases below both address clear aligner therapy using ClearCorrect technology for two different indications.

**Case No. 1**

The patient in this case is a 30-year-old healthy male whose chief complaint was “the spaces between his upper front teeth” along with “crowding in his lower front teeth.” His past dental history, clinical examination and panoramic radiograph revealed a caries-free dentition, no periodontal disease, and no missing teeth other than a congenitally missing upper right lateral incisor and his
3rd molars, which had been removed 10 years previously. He presented with multiple abfractions associated with his occlusion and parafunction, and a 4-mm midline shift (Figures 2, 3). The patient had never received orthodontic treatment. He had recently received two consultations and opinions on treatment for his chief complaint, and came to my office to obtain a third opinion. As always, I discussed all options with the patient without looking at the other opinions. After discussion, the patient decided on the recommended treatment.

Treatment would involve clear aligner therapy to create space and a functional arch form. This would be followed by placement of an implant and implant-supported crown in the newly created space, and cosmetic restorative treatment for the abfractions. The estimated treatment time was 9 months for clear aligner therapy followed by 3 months for implant, restorative, and cosmetic treatment, for a combined 1-year start-to-finish treatment plan. A clear retainer would be required afterward to prevent relapse in the lower arch.

Digital scans and images were taken, and uploaded to ClearCorrect’s site. Two distinct series of aligners were planned, which would allow the addition of a pontic as an interim solution until more space had been created. The initial treatment plan setup was created and the first aligner series planned (Figure 4). After reviewing with the patient and agreeing on the plan, the aligners were fabricated and sent to us. By 6 months, the patient had worn 12 sequential sets of clear aligners. Significant space had been created, for future implant placement in the upper right lateral incisor position, crowding in the lower anterior region almost eliminated, and the midline shift significantly reduced (Figure 5).

New scans and images were taken at 6 months for the remaining aligners, with a virtual pontic included in the setup for viewing and approval. Aligner #13 also included the use of engagers (marked in blue in the setup) that would help to control and enhance tooth movement (Figure 6). We viewed the setup, and after approving it without any adjustments,
the remaining aligners were fabricated with voids for the engagers at the sites for teeth #4, 11, 21, 22, and 27. To create the engagers, the enamel was acid-etched at the precise location where the engagers would be placed, rinsed off, and dried, then bonding agent was applied and light-cured. After applying petroleum jelly as a separator inside the voids within the aligners, two-thirds of the depth of the voids for engagers were filled with universal composite, and the remaining third that would be against the tooth was filled with flowable composite (Figure 7).

By 9 months, sufficient space had been created to place an implant and crown, the midlines matched, and the lower
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Figure 8a—Stable presentation for the upper teeth prior to implant placement. Mid-course therapy with additional aligners continued for the lower teeth during the healing stage of the implant.

Figure 6—Setup with virtual pontic and engagers

Figure 7—Aligner with composite pontic and engagers

Figure 8b—Upper arch at 9 months with adequate space for an implant

Figure 9—Comparison of space pre- and post-treatment with clear aligners showing the pontic within the clear aligner in the image on the right

Figure 10—Implant placed at site #7
anterior teeth were no longer crowded (Figures 8, 9). At 9 months, a surgical guide was fabricated. During the course of the implant placement and subsequent healing phase, the lower teeth had a continued course of clear aligner therapy for 5 more aligners and the upper teeth were maintained with nonactive aligners with an incorporated pontic. The implant was placed 1 month later, followed by a 1-week postoperative visit and uneventful healing. The custom abutment and temporary crown were placed 2 months later (Figures 10–12). The patient also wanted to have his teeth whitened, for which we used a laser, and esthetic bonded composites were placed over the abfractions. The patient was delighted with the result (Figure 13).

**Case No. 2**

This is my “Dubai/9500 mile case.” After I had just returned from a mission in Haiti, a walk-in patient who was 12 years-of-age from Dubai came into my office with her father while they were vacationing, after she had begged him at home for clear aligners and he had promised that he would let her have them. The problem was that they were leaving 4 days later to return home. She presented with a crossbite of the upper right lateral incisor, and crowding of the upper and lower dentition. (Figure 14) After an evaluation and radiographs, a long debate, and a call to the company to describe my dilemma (time, difficult case, long distance), we decided to proceed with digital scans at this appointment. Within 4
days we had taken digital scans and images, reviewed and approved the treatment plan setup for correction of her crowding and crossbite, the aligners had been shipped to us overnight, and the first aligner set and engagers were placed (Figure 15). This young lady smiled from ear to ear now that she had her clear aligners. After returning home, she continued to wear her aligners, swapping them out at the agreed times and staying in touch remotely. I visited Dubai at the 6-month follow-up, and took digital scans and images for the next series of aligners. At 6 months, the crossbite was resolved and only minor crowding and adjustments were still needed. Treatment continues and should be completed in the next 2 months. The already dramatic change has delighted this patient and her father (Figures 16, 17).

Discussion

The above cases highlight different aspects of clear aligner therapy. The patient in the first case had previously received two different opinions. The first clinician gave one option, with an estimated time of 4 to 6 weeks. It was for full-coverage crowns for the maxillary anteriors to make tooth #6 look like a lateral incisor and #5 like a canine, and veneers for the lower anterior teeth. The second opinion recommended FOA for a period of about 2 years, followed by an implant-supported restoration at site #7 and veneers for the upper anterior teeth. The patient had been told that clear aligners were not suitable. An approach similar to the first opinion would have been considered for the first case if...
the patient had refused our first recommendation for clear aligners. In the end, clear aligner therapy combined with conservative restorative treatment produced an excellent result and a happy patient. It is worth mentioning that studies on clear aligners have been conducted since the late 1990s and conclusions based on the studies available, spanning a number of years. Studies showed that some tooth movements were difficult to achieve, or that predicted vs actual results differed although clinically acceptable. However, significant advances have occurred in clear aligner therapy in the last five years, including the use of precise, treatment-planned auxiliaries that better control and promote planned tooth movement and the addition of newer systems.

In the second case, the ability to remotely steer treatment, and for the patient to continue with her series of aligners made treatment possible despite geographic limitations. Unlike emergencies resulting from breakage of wires or debonding of brackets, there are also few emergencies with clear aligners and if a replacement aligner is needed due to the original being misplaced/lost, this is easily resolved using existing digital images. This is a significant benefit for patients, avoids potential irritation as well as inconvenience, and no additional chair time is required. It can also be beneficial in cases where treatment visits are intermittent and treatment is otherwise remote.

Better oral hygiene with less plaque and gingivitis is generally observed in patients wearing clear aligners vs FOA. A clear aligner does not create a plaque trap, can be removed prior to oral hygiene, and can be cleaned while outside the mouth. Orthodontic decalcifications are an additional and...
significant concern for patients wearing FOA,15 but not for patients wearing clear aligners. Patients also report significantly less discomfort with clear aligners than with FOA.16

**Practice Building**

Adults have driven the increased demand for clear aligners and adapt easily to them without a significant impact on self-esteem.17 Children and adolescents 8 to 17 years of age have also indicated a preference for clear aligners over FOA and other appliances.18 In comparison to other orthodontic treatment options, clear aligners were rated significantly higher on attractiveness and acceptability in another survey, and this correlated with patients being willing to pay more for them.19 Being able to take digital scans and clinical images is comfortable for patients, and rapid turnaround and access through a doctor portal makes it possible to show patients the proposed end result on the screen and go over what steps would be needed. This is helpful for case acceptance and as a practice builder. Treatment with clear aligners also requires less chairside time and shorter treatment times than FOA for mild to moderately complex cases.20 Few patients report they would not have undergone clear aligner therapy after experiencing it, and in one study 98% would still have done so compared to 78% for FOA.16

Experienced clinicians can use clear aligners to treat the deciduous and permanent dentitions. Although clear aligner therapy can be used for dental expansion, skeletal expansion is best treated using standard orthodontic treatment with expanders. It is important to check whether the patient is being compliant with wearing the aligners 22 hours per day. The first telltale sign that a patient is non-compliant is when he/she arrives not wearing the aligner. Sending out text blasts reminding aligner patients that they should be wearing them helps by regularly reminding them.

**Conclusions**

Clear aligners have truly transformed orthodontic treatment and made it more accessible and more desirable to adults and teenagers. Starting with simple cases builds experience before graduating to more complex cases, and good support is essential. With proper treatment planning, excellent results can be obtained even when treatment is partially remote as shown here. Clear aligners also offer an effective, conservative, and relatively quick method to enhance esthetic and functional outcomes in restorative care.

**References**

5. ClearCorrect. Parameters for Selecting a Case. Available at: https://support.clearcorrect.com/hc/en-us/articles/20667697-Parameters-for-Selecting-a-Case
8. Engagers. Available at: https://support.clearcorrect.com/hc/en-us/articles/203836198-Engagers-aka-Attachments-
1. ______ is a reason given for the increase in the number and proportion of orthodontic cases treated with clear aligners.
   a. The perceived importance of function
   b. The perceived importance of occlusion
   c. Improved esthetics during treatment
   d. All of the above

2. The genesis of clear aligner therapy began in ______ with the use of thermoplastic full tooth-coverage appliances.
   a. 1924
   b. 1944
   c. 1964
   d. 1984

3. Class II malocclusions can be treated with clear aligners.
   a. True
   b. False

4. Intraoral images that are of the occlusal view should be taken using ______.
   a. cheek retractors and a saliva ejector
   b. cheek retractors and intraoral mirrors
   c. cheek retractors, a saliva ejector, and intraoral mirrors
   d. cheek retractors, occlusal markers, and intraoral mirrors

5. Compared to traditional impressions, intraoral digital scans ______.
   a. are easier for patients
   b. are easier for clinicians
   c. result in digital models that are at least as accurate as traditional models
   d. all of the above

6. For complex cases, it is essential that all scans are taken at the start of treatment to avoid having to repeat the workflow.
   a. True
   b. False

7. Auxiliaries ______.
   a. allow for more difficult tooth movement but reduce aligner retention
   b. are created on the outer aspect of the aligner
   c. are created by 3-D printing, then attached to the tooth
   d. provide greater control over tooth movement

8. The need for, and type of, auxiliaries is determined ______.
   a. by the software program
   b. by the laboratory technician
   c. chairside
   d. by the patient

9. Engagers can be used to attach ______ for traction to distalize upper posterior teeth.
   a. wires
   b. elastics
   c. screws
   d. all of the above

10. Interproximal reduction can be performed to ______.
    a. remove proximal enamel
    b. avoid orthodontic extractions
    c. create a small to moderate amount of space
    d. all of the above
11. Clear aligner therapy prior to restorative care can be performed to _________.
   a. shorten teeth  
   b. close or open spaces  
   c. orthodontically extract teeth  
   d. improve the shape of adjacent teeth

12. The patient’s level of commitment and anticipated compliance with aligner use must be assessed prior to embarking on treatment, because _________.
   a. treatment is shorter than with FOAs  
   b. the aligners will only be worn for 12 hours a day  
   c. the aligners must be worn even when the patient is eating  
   d. the aligners should be worn almost all day and night

13. A clear retainer is used after clear aligners to _________.
   a. prevent arch relapse  
   b. fine-tune tooth movement  
   c. treat bruxism  
   d. treat sleep apnea

14. While extra space is being created for an implant, a pontic can be fabricated inside the aligner to fill the existing amount of space.
   a. True  
   b. False

15. In order to prevent composite from adhering to the inside of aligners while engagers are being created, _________ should be applied as a separator.
   a. acid etch  
   b. petroleum jelly  
   c. gel activator  
   d. temporary cement

16. Children and adolescents 8 to 17 years of age have indicated a preference for fixed orthodontic appliances with multicolored brackets over clear aligners.
   a. True  
   b. False

17. If an aligner needs to be replaced due to misplacement or loss, _________.
   a. existing digital images can be used  
   b. treatment is delayed by a month  
   c. new scans must always be taken  
   d. make sure to charge the patient for it

18. Orthodontic decalcifications are _________.
   a. not a significant concern for patients wearing FOA  
   b. a barrier to clear aligner therapy  
   c. not a significant concern for patients wearing clear aligners  
   d. a significant concern whether the patient is wearing an FOA or a clear aligner

19. In one survey, clear aligners were ________ other orthodontic treatment options.
   a. perceived to be more bulky than  
   b. rated significantly lower for compliance than  
   c. rated significantly higher on acceptability than  
   d. perceived to be too thin compared to

20. Clear aligners can offer an effective, conservative, and relatively quick method to enhance esthetic and functional outcomes in restorative care.
   a. True  
   b. False
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**EDUCATIONAL OBJECTIVES**
1. Describe the types of movements that can be achieved using clear aligners.
2. Review the digital workflow for clear aligner therapy.
3. Define the role of auxiliaries and describe how these are used for clear aligner therapy.
4. Delineate the potential benefits of clear aligner therapy for patients, including those requiring restorative care.

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Please evaluate this course using a scale of 3 to 1, where 3 is excellent and 1 is poor.

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Fill in the circle of the appropriate answer that corresponds to the question on previous pages.

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
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A 19-year-old female presented in my office with dental trauma. While at a party, she became intoxicated, passed out, and hit her front tooth on a beer keg. She had then received emergency treatment elsewhere. The patient presented in my office with pulpal extirpation, partial crown lengthening, and a temporary crown.

After removing the temporary crown, we found a knife-edge margin that was completely violating biologic width, even after partial crown lengthening by a local periodontist. We completed the endodontic treatment, placed a titanium post (Brasseler USA) and a core buildup was fabricated using bonded resin-based composite. I then revised the preparation with a chamfer, bringing it coronally out of the biologic space. The previously created knife-edge prep was left uncovered, hoping for new attachment or reattachment, which ultimately did occur.

Photos and hand sketches were sent to the lab detailing the restoration. A zirconia-based crown was ordered to create some masking, as well as lifelike translucency. The final crown was cemented with RelyX luting cement (3M ESPE).

After just 3 weeks, the periodontium responded beautifully. In addition, the final contour, hue, and value of the single crown are virtually flawless. The chroma, however, is a bit too intense in the cervical third.

The patient and her family were very pleased with the result, especially after only 3 weeks. Unfortunately, I was only able to follow the patient for about 1 year, after which she relapsed into drug use and ultimately was incarcerated. This case exemplifies how even the most challenging patients with difficult circumstances deserve our care, compassion, and very best efforts.

Figure 1—Preoperative presentation with an acrylic temporary fabricated by another clinician.

Figure 2—Preoperative view of the preparation.

Figure 3—Note the significant infringement into the biologic width.

Figure 4—Postoperative wide view. Note the excellent gingival response and nice resulting crown.