# Using Technological Advances to Treat the Crowded Anterior Dentition

*by* Dino S. Javaheri, D.M.D.

*Dr. Javaheri graduated from the Tufts University School of Dental Medicine in 1993, after which he completed a two-year AEGD program at University of the Pacific (UOP) School of Dentistry. Dr. Javaheri is the course director of UOP's "The Esthetic Revolution" and "Smile Reconstruction" continuing education programs. The author of numerous articles in dental journals, Dr. Javaheri is actively involved in promoting quality care through local organizations and study clubs, and through lecturing nationally and internationally. He has no affiliations or financial interest in any of the products or manufacturers mentioned in this article. Dr. Javaheri maintains a practice limited to complex restorative and esthetic dentistry in Danville, California. He can be reached at drj@drjavaheri.com.*

## ABSTRACT

Innovative dental techniques and procedures are constantly being developed. Dentists and patients alike are benefiting from these new procedures via lasers, computer-aided design/computer-aided manufacturing (CAD/CAM), digital imaging, and many other new techniques. These state-of-the-art technological advances allow dentists to provide patients with greater treatment options and services. The case presentation discussed in this article demonstrates the use of technological advances to treat a crowded anterior dentition and to restore a maxillary central incisor with a crown.

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## INTRODUCTION

Technology has changed the way we practice dentistry, benefiting both practitioners and patients. New materials and techniques have been developed from these advances that offer improved esthetics, efficiency, and tooth conservation. We can now utilize digital photography, CAD/CAM restorations, lasers, shade-matching software, and three-dimensional computer imaging to provide our patients with more durable and predictable treatment. The case study presented reviews the use of technology in treating a crowded anterior dentition. Orthodontic aligners using three-dimensional computer imaging, a diode laser for soft tissue recontouring, computer software for shade matching, and a CAD/CAM restoration were utilized to achieve an esthetic and conservative result.

*Figure 1: Full-face preoperative view of patient unhappy with esthetics of anterior teeth.*

*Figure 2: Facial view displaying crowding and uneven tissue heights.*

## ORTHODONTICS

Many adult patients who desire cosmetic enhancement of their crowded dentition do not want to have traditional braces.[1,2] Invisalign (Align Technology, Inc.; Santa Clara, CA) offers an alternative for these patients,[1,2] who therefore are more likely to accept orthodontic treatment. Invisalign uses three-dimensional computer imaging technology to create clear plastic trays that can move teeth.[3-5] A series of practically undetectable aligners are changed every two weeks to achieve the desired results. Invisalign can also be a useful tool for limited movement of teeth/root positions to set up esthetic restorative treatment.

## DIODE LASER

Lasers create an intense beam of light energy that moves through a fiber-optic cord. When this light energy enters the targeted tissue, the energy is converted into heat as a result of the tissue's pigmentation. A photo-thermal reaction occurs that results in a thermal effect causing vaporization or ablation of this targeted tissue, with very little collateral tissue damage. Diode lasers give practitioners a reliable way to reshape and recontour the gingival tissue to optimize symmetry and maximize esthetics.[6-8]

***Shade determination has always been a challenge for practitioners because of the abstract nature of color science.***

## SHADE MATCHING

Precise color communication is integral to the development of esthetic harmony. However, shade determination has always been a challenge for practitioners because of the abstract nature of color science.[9,10] Recently, the dental profession has been introduced to technologies dedicated to the analysis and communication of shade (e.g., ShadeVision [X-rite, Inc.; Grandville, MI]; Shade-Eye-NCC [Shofu Dental Corp.; San Marcos, CA]; ShadeScan [Cynovad; Saint-Laurent, Quebec, Canada]).[11-13] The current predominant disadvantage to these systems is cost.

ClearMatch (Clarity Dental Corp.; Salt Lake City, UT) is a unique system in that it requires minimal investment by the dentist and is simple to use. ClearMatch uses a patented method of color analysis to accurately measure shade and value information. By using a standardized black and white tab along with a Vita (Vident; Brea, CA) shade tab when acquiring images using a high-resolution digital camera, the ClearMatch software can "normalize" images prior to performing the desired analysis (*normalizing* means adjusting hues to compensate for any color imbalances that occurred when the image was taken). It is important to realize that digital photographs by themselves will not yield shade-matching results, as each camera will interpret color differently.

## CAD/CAM RESTORATIONS

There are currently several indirect restorative systems that use CAD/CAM technology to fabricate high-strength zirconium-based restorations (e.g., LAVA [3M ESPE; St. Paul, MN]; Cercon [Dentsply Ceramco; York, PA], and Everest [KaVo; Biberach, Germany]).[14,15] For this process, an impression or wax-up is scanned into a computer to produce a three-dimensional model. An image of the coping form can be designed. This information is then sent to a milling

*Figure 3: Occlusal view shows that #7 and #10 are flared out, while #8 and 9 have a lingual tilt.*

*Figure 4: After six months of treatment the teeth had moved into proper positions.*

machine, where a presintered block of zirconium is shaped. The bridge or crown framework is sintered in the high-temperature furnace to attain its exact dimensions, density, and final strength. Finally, a layer of feldspathic porcelain is applied to achieve final esthetics and contours.

The new CAD/CAM zirconium-based restorations offer dentists two distinct advantages over traditional fired or pressed feldspathic porcelain: stronger restorations and better color masking.

## Treating Anterior Crowding

Before determining the possible treatment options for esthetic results with a crowded dentition, several questions must be answered.[16-19]

### Will veneers be necessary for cosmetic reasons even if orthodontic treatment is completed?

The answer to this question depends on the patient's expectations and the condition of the existing dentition. If the patient's cosmetic expectations can be met by orthodontically straightening and bleaching the teeth, then orthodontics should be seriously considered as the treatment of choice. However, if the teeth need to be lengthened or the sizes of the teeth do not match each other, then veneers are required to correct the tooth shape discrepancies even if orthodontic therapy is completed. In cases where veneers are necessary for a cosmetic result, orthodontics may not provide much benefit. However, orthodontics can still be of great benefit in cases of crowded teeth. By moving the teeth into the correct positions, aggressive preparations can be avoided. In addition, the number of teeth requiring restorations may be dramatically reduced from orthodontic alignment.

### Can the occlusion be managed without orthodontic treatment?

In the first question, we were evaluating treatment options from a cosmetic standpoint. In this question, we are assessing how we can achieve functional results. If the patient's teeth are malpositioned, orthodontics can reposition the teeth into proper function. In some cases, achieving restorations in the ideal position may require aggressive preparations, leading to severe compromise of tooth structure or even root canal therapy. In severe crowded cases, the restorative options may be nonexistent. With crowded or rotated teeth, the patient often must make the final decision between orthodontics and a limited number of veneers or full-mouth rehabilitation with crowns. In other cases, orthodontics may improve the occlusion, but provide no real benefit if the same number of restorations will be necessary to ensure a functional outcome. So, a decision must be made from a functional standpoint as to whether orthodontic treatment is necessary, beneficial, or ineffectual.

### Are gingival tissue heights in line and in correct position?

Often, tissue height discrepancies can be corrected with gingivectomy procedures. However, in certain situations, crown lengthening is needed for osseous recontouring to correct the gingival levels. This may lead to a compromise in crown-to-root ratio and expose root structures. Another option is to correct the gingival levels with orthodontics, then correct the incisal edge positions with restorative treatment.

*Figure 5: A normalizing software system was used for shade matching.*

*Figure 6: The excess tissue on #8 was trimmed with a diode laser.*

## CASE STUDY

### TREATMENT PLANNING

A 38-year-old female presented for esthetic enhancement of the anterior detention. Her main concern was her maxillary incisors. The laterals were flared out, while the centrals were in lingual version. In addition, the right central incisor had a ceramic crown that appeared gray. This tooth had received root canal therapy approximately 10 years earlier. The right central incisor also appeared short due to excess gingival tissue that compromised its width-to-height ratio (Figs 1–3). The tissue above the right central incisor appeared slightly gray due to the tooth being non-vital.

Upon clinical examination consisting of full-mouth radiographs, hard and soft tissue charting, diagnostic models and photographs, and a thorough evaluation of the patient's occlusion, the orthodontic and restorative options were evaluated.

The three orthodontic analysis questions addressed previously, were applied to the preoperative photographs, models, and clinical examination.

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For ideal esthetic results, will restorative treatment be necessary even if orthodontic treatment is completed? In this case, if orthodontic treatment were accomplished, a single new restoration would be necessary to achieve the correct length and color of the right central incisor. Esthetic results, utilizing a combination of veneers and crowns, could be achieved without orthodontics. However this would necessitate aggressive reduction of some teeth and possibly damage pulpal health.

Can the occlusion be managed without orthodontic treatment? This question could not be answered from photographs, but rather from the mounted models and a diagnostic wax-up. Two options existed for establishing proper anterior guidance for this patient. The case could be treated with orthodontics or with anterior porcelain restorations.

Are gingival tissue heights in line and in correct position? The right central incisor displayed excess tissue. This problem could have been corrected with crown lengthening. However, this would involve a surgical procedure and compromise the crown-to-root ratio. If orthodontics were done, the tooth could be intruded to a point where a gingivectomy would align the tissue.

After reviewing the advantages, disadvantages, time requirements, and finances for each treatment options, the patient accepted the following treatment:

- orthodontic movement of maxillary and mandibular teeth

*Figure 7: Crown preparation of tooth #8.*

*Figure 8: Postoperative photograph after orthodontic treatment and a new crown.*

*Figure 9: Postoperative occlusal view showing alignment of anterior teeth.*

*Figure 10: Postoperative full-face photograph.*

- tissue recontouring of the right central incisor
- new crown on right central incisor.

## PROCEDURE

For the orthodontic phase, two goals were outlined: to correct anterior crowding and to intrude the right central incisor. The patient was not amenable to having traditional braces, due to esthetic concerns. Clear aligner trays from Invisalign provided an option that was acceptable to the patient's esthetic concerns and could achieve the orthodontic goals. To start treatment, vinyl polysiloxane impressions, bite registration, photographs, and radiographs were sent to Invisalign's manufacturer, along with an outline of the treatment goals. A three-dimensional computerized simulation of the patient's dentition was created and the desired movements were planned out. Clear aligner trays were then fabricated for the maxillary and mandibular teeth. To create space for tooth movement, interproximal reduction was done (2.2 mm in the maxillary arch and 0.4 mm in the mandibular arch). After six months the final orthodontic goals were achieved (Fig 4).

High-resolution digital photographs were taken for laboratory

communication. Additional photographs were taken with the Clear-Match tab and a Vita A2 shade tab for color matching (Fig 5). This data was color-balanced with the Clear-Match software.

To correct the position of the tissue on the right central incisor, the biological width (the amount of healthy tissue that must remain above the bone level) had to be considered. In the biological width, gingival fibers are in direct contact with the tooth. This acts as a barrier to the bacteria in the sulcus. To ensure that tissue removal does not impinge on the biological width, the depth of the sulcus should exceed the amount of tissue to be removed.

After careful measurements, it was determined that trimming the excess tissue would not impinge on the biological width. The amount of excess tissue was marked and removed with a diode laser (Fig 6). The existing crown was removed and the preparation was completed for a new ceramic crown (Fig 7).

Due to the black spots and the overall dark color preparation, a zirconium-based CAD/CAM system, Cerec inLab (Sirona Dental Systems; Charlotte, NC), was chosen for the final restoration. Along with its high strength, zirconium copings are also opaque enough to block out the color of dark preparations. At the cementation appointment, the temporary was removed and the new restoration was tried in. After patient approval the restoration was cemented. Occlusion was checked and adjusted as needed for proper function and guidance. The patient was very pleased (Figs 8–10). New retainers were fabricated to maintain the position of the teeth.

## CONCLUSION

As technological advances are introduced into dentistry, the options available to practitioners and patients will continue to increase. In the case described here, the techniques used allowed for a more comfortable treatment and gave predictable results. As with any material or technique, proper case selection and understanding of the contraindications and limitations is mandatory for predictable success with new technology.

***Acknowledgement***

*The author would like to acknowledge Frontier Dental Laboratory (El Dorado Hills, CA) for fabricating the restoration presented in this article.*

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*"What sunshine is to flowers, smiles are to humanity. These are but trifles, to be sure; but scattered along life's pathway, the good they do is inconceivable."*

*~ Joseph Addison*