CORRECTING Anterior Crowding

Using Orthodontic Therapy & Conservative Esthetic Treatment: A Case Report

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Abstract

Anterior crowding is one of the more challenging cosmetic clinical situations. Esthetic enhancement of such cases may involve orthodontics, veneers, both, or full-mouth rehabilitation with crowns. Adult patients seeking orthodontic treatment are increasingly motivated by esthetic considerations. Most of these patients reject wearing traditional fixed appliances; rather, they are seeking more esthetic treatment options, including lingual orthodontics and Invisalign appliances. This article discusses a smile design case to treat a crowded anterior dentition using the Invisalign appliance, followed by full-crown porcelain veneers and a zirconia crown restoring the maxillary anterior teeth.

Key Words: anterior crowding, smile analysis, esthetic design, Invisalign system, indirect porcelain veneers
Introduction

Many adult patients who desire cosmetic enhancement of their crowded dentition do not want traditional braces. The Invisalign system (Align Technology, Santa Clara, CA) is a technologically advanced esthetic approach to treating malocclusion, which offers an alternative for these patients who are reluctant to accept orthodontic treatment.

Invisalign uses three-dimensional computer-imaging technology to create clear plastic trays that can move teeth. 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 to prepare for esthetic restorative treatment.

Treatment Options for Correcting Anterior Crowding

From a cosmetic standpoint, if orthodontically straightening and bleaching the teeth can meet the patient's expectations, then orthodontics should be considered. However, if the teeth need to be lengthened or the sizes of the teeth do not match, then veneers are required to correct the tooth size discrepancies even if orthodontic therapy is completed. In many cases, combining orthodontics with veneers provides a conservative esthetic outcome by avoiding aggressive tooth preparation if veneers are to be used alone.

From a functional standpoint, the patient's occlusion may be managed with orthodontics or restorative options that are either veneers or full-mouth rehabilitation with crowns.

Using the Invisalign system, crowding can be corrected by dental expansion, which can be accomplished in several ways. One method is that all the teeth move at the same time; expansion occurs as teeth move to eliminate the crowding. In another method, the first premolars through second molars expand first. When space appears distal to the canines, the canines move distally, creating space anteriorly, which can then be used to correct crowding in the anterior region.

According to Boyd and colleagues, a candidate for treatment with Invisalign should have fully erupted permanent teeth, growth should have minimal or no effect on treatment.
A gradual decrease in maxillary incisor exposure was reported for each increase in age group from under 30 to over 60, where the mean tooth exposure of the maxillary central incisor reported among the 30- to 40-year-old age group was 1.6 mm.  

The results of a study conducted by Misch8 revealed that there was a large range of maxillary incisor exposure in relation to the maxillary lip line, whereas the range of canine exposure was narrower for the different gender and age groups. Accordingly, it was suggested that the average canine exposure dimension could be used clinically to assess anterior incisor edge position.

In an aesthetic smile, it is ideal to have no more than 2 mm of gingiva showing when the patient is in full smile.9 and the incisor line comes very close to and almost touches the lower lip, being no more than 2 mm away.9

In this case, the patient presented with 6 to 7 mm maxillary central display at rest, and more than 2 mm between the incisal line and the lower lip with a reverse smile line. As for the amount of gingival display, #9 showed an actual amount of display, however, #8 displayed none (2 mm). The canines’ exposure was used to establish the position of the incisal edge to avoid an aged-looking smile. The average incisor maxillary central incisor exposure was used instead.9

Establishing Length and Tissue Heights of the Central Incisors

After locating the incisal edge position, the length and tissue heights of the central incisors were established. A true drawing of a traced straight-on photograph was used to apply design concepts. The tracing showed how the tissue and teeth needed to be placed for the end result, and thus helped to define the treatment plan.

Using tracing paper, the patient’s teeth were outlined. The new incisal edge position and the gingival position were then placed on the working outline (Fig. 4).

![Figure 4: Preoperative tracing of anterior teeth with superimposed tracing of diagnostic wax-up.](image-url)

**Treatment Plan**

The treatment plan presented the following recommendations:
- periodontal treatment (scaling and root-planing)
- diagnostic, preoperative models were presented to the patient, along with a drawn smile analysis to assist in determining the options and course of treatment
- invisalign appliance to achieve the following treatment goals:
  - correct crowding of the maxillary incisors by expansion of both maxillary and mandibular arches and interproximal reduction (IPR) of anterior teeth
  - align upper midline to lower midline by moving maxillary midline so that the patient’s right with IPR
  - correct deep bite by intruding lower anterior incisors if needed, while maintaining anterior guidance and cuspide rise
  - expand the arch in the premolar region for a more esthetic buccal corridor
  - #6/#7 to match ideal cervical gingival level of #9, and the excess tooth length would be filed as needed
  - gingival margins recontouring for #49-11 to match that of their right counterparts using a Biolase laser (Biolase Technology, San Clemente, CA)
  - bleaching
  - restorative therapy to replace the old porcelain veneers on #8 with zirconia crowns; and fabricate porcelain veneers for #6 and #7 and #49-11 to change the shape, size, and color of the teeth for a more esthetic smile.

**Smile Design**

**Establishing Location of the Incisal Edge**

One of the most important factors for a successful esthetic outcome is locating the position of the incisal edge, as determined by occlusion, phonetics, and esthetics. The degree of lip movement is an important factor in determining location of the incisal edge; the less the lip moves during a smile, the more teeth will show at rest to achieve enough tooth display when smiling. Ideally, this is to show the free gingival margin of the centrals which are 9.5 to 11 mm.9

![Figure 5: Post-orthodontic treatment; retracted frontal view. Note the improved smile line and corrected crowding of teeth.](image-url)

**Smile Design Assessment**

An Ideal Esthetic Smile

#7 and #8 should show when the patient is in full smile, and the incisal line should come very close to and almost touch the lower lip, being no more than 2 mm away.

This Case

The patient presented with 6 to 7 mm maxillary central display at rest, and more than 2 mm between the incisal line and the lower lip with a reverse smile line. As for the amount of gingival display, #9 showed an ideal amount of display; however, #8 displayed none (0 mm).
still esthetically unpleasing. To achieve the youthful, uniform smile the patient desired, a clinical mock-up was completed and the proposed new size of incisors and new shape of canines (more rounded) were evaluated for esthetics, phonetics, and occlusion. After the patient's approval, it was determined that the patient's esthetic needs could be satisfied by restoring #8 with a zirconia crown and #6, #7, and #9-11 with porcelain laminate veneers to correct the remaining esthetic issues (Figs 6 & 7).

- Canted midline
- Discrepancy in shape, length, and width between #8 and #9, and between #7 and #10
- Asymmetrical gingival level between #6 and #7, and between #10 and #11
- Sharp, aggressive-looking canines.

Preparation
At the preparation appointment, before preparing the teeth, the gingival zenith of #8-11 was raised slightly to be symmetrical with their incisor at the enamel plane using a Bioclear laser. The crestal bone was sounded and found to be 3.5 mm from the free gingival margin. The existing veneers were removed from #8 and was prepared for a full-coverage zirconia crown. Preparation for veneers on #6, #7, and #9-11 was done guided by reduction templates to ensure proper tooth reduction. The preparations extended 0.5 mm sub-gingival and the lingual margins were placed at the incisal marginal ridge for maximum strength of the tooth and the restoration. Lingual margins should not be placed in the interproximal area, which is the area with the highest concentration of stress on the entire tooth.

The teeth were prepared in such a way as to give the laboratory 2.0 mm of clinical and 1.5 mm of facial room to develop subtle internal characteristics with porcelain. The gingival proximal area extended lingually at the crest of the papilla to provide adequate porcelain to eliminate black triangles. Final impressions were taken and provisional restorations were made. The occlusion was adjusted and an alginate impression of the provisional restorations was taken and poured in stone, to be sent to the laboratory (Figs 8-11). Photographs of the provisional and the patient's face with the provisional were taken for better communication with the laboratory. A few days later, the patient came in for a postoperative check of his provisional and bleaching was done at the same appointment.

Stump shades were chosen a few days after bleaching, and photographs were taken of the preparations with stump guides in view for the laboratory's use (Fig 12).

Figure 6: Post-orthodontic treatment; axial inclination of maxillary anterior teeth. Note the canted midline and discrepancy in size and shape between #8 and #9, as well as between #7 and #10.

Figure 7: Post-orthodontic treatment; gingival heights of maxillary anterior teeth.

Figure 8: Model of the provisional was made to communicate with the laboratory.

Figure 9: Frontal view (open) of provisional model to check emargination.

Figure 10: Frontal view (closed) of provisional model to check length of restorations compared to the provisional.

Figure 11: Occlusal view of provisional model to check incisal emargination, locking, and anatomy.

Figure 12: Shade tab: M1.

Laboratory Communication
A detailed prescription was sent to the laboratory, along with the mock-up and a smile analysis. Also sent was a full series of 35-mm digital photographs showing the following:
- 12 preparative views recommended by the AACD
- Preparations for stump shading
- Stumpbrite for proper establishment of midline and horizontal plane
- Face and full smile with the provisional restorations seated in the mouth.

Models of the provisional, along with the bite records, original facebow-mounted casts, and a bite fork of the prepared maxillary teeth and shade-matching instructions were sent to the laboratory. Progressive shades were selected to blend with the patient's natural teeth.

The challenge in this case was to match the #8 zirconia crown with feldspathic porcelain veneers on #6 and #7, and #9-11. CZR porcelain (Kuraray Noritake Dental Tokyo, Japan) was used to achieve the same type of light reflection throughout the whole anterior zone. A subtle gradation of color was applied not only from gingival to incisal for a polychromatic effect, but also a gradation of color from centrals to canines to create a natural progression of color to blend into the bucals for a seamless transition to the buccal corridor. We started with a 1M1 Vita Shade (Vident, Boca, CA) on the centrals and blended to a 1M1 incisal 1M2 gingival toward the canines. Along with subtle microtextural characteristics in the form of slight striations and bamboo halo effect at the incisal edge, an appearance of added depth and life was incorporated into the restorations. A moderate surface texture was also applied to break up light and cause a definite glaze pattern, adding to the realism of the restorations. To avoid over-glazing the hand polished, we applied so that when the restorations are presented with natural moisture all the internal and external features would provide a more realistic and vibrant outcome.
Seating Appointment
Two weeks after the preparation appointment, the patient was seen to seat the restorations. Each veneer was checked individually on the teeth, then they were checked again on the prepared teeth as a group. Interproximal contacts were checked and adjusted as needed. The patient was very pleased and he approved them for final cementation (Figs. 13 & 14). The veneers were seated, cured, and finished one at a time, except for the zirconia crown for #9 and veneer for #7, which were seated together in order to control the midline. Teeth #2, #10, #6, and #11 were seated in that order. When #7 was seated, #6 was held in position without cement to ensure proper seating of #7; this same procedure was followed for the remaining teeth.

Pre- and post-treatment facial and full-smile views (Figs. 15a-17b) show good alignment of the anterior teeth and symmetry of the midline; a pleasing smile line following the patient's lower lip; symmetrical right and left centrals, laterals, and cuspids; and ideal gum level of maxillary anterior teeth. The right maxillary and maxillary lateral incisors were selected to match the patient's natural dentition, resulting in seamless, natural-looking restorations.

"Using the Invisalign system, crowding can be corrected by dental expansion, which can be accomplished in several ways."

Figure 13: Post-restorative treatment; retracted frontal view. Final restorations with even gingival architecture, and symmetrically shaped and sized centrals.

Figure 14: Post-restorative treatment; gingival heights of maxillary anterior teeth.

Figure 15a: Pretreatment; the patient's relaxed attempt to smile.

Figure 15b: Post-orthodontic treatment; full smile, r.l. Note the good alignment of maxillary anterior teeth after using the Invisalign appliance.

Figure 15c: Post-restorative treatment; full smile, r.l. Completed treatment reflects a more symmetrical and pleasing smile.
Summary

The Invisalign system provides new opportunities to treat adult patients who otherwise would not consider conventional orthodontic treatment. In this case, because the treatment plan involved orthodontics, both esthetic and occlusion results were enhanced. Also, the veneer preparations in this case were very conservative since the teeth were aligned into the proper position. The patient was very pleased with the final results.

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References