

A Systematic Approach to Anterior Esthetics



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To successfully complete a rehabilitative esthetic treatment, a team composed of the treating dentist, a dental ceramist, and the necessary specialists must be formed. The success or failure of the treatment depends on the knowledge and skills of the treating dentist, who must be the director/organizer of the treatment and must fully understand the potential contributions of each team member. A careful treatment plan must also be developed. The plan should contain the correct steps placed in a logical sequence and com-

municate the necessary information to each member, allowing them to idealize his or her individual contribution to achieve the best possible result for the patient.

CASE STUDY

A 44-year-old woman presented with the desire to improve her unesthetic smile. She rejected orthodontic treatment and had no history of occlusal, periodontal, or muscular complications. The patient had a congenitally missing upper right cuspid that created anterior diastemas. The treatment goals were to close the spaces, improve anterior guidance, and improve the esthetic appearance of her smile.

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A good starting point for any esthetic rehabilitation is the position of the intersection of the incisal plane and the vertical midline of the maxillary central incisors relative to the facial and skeletal landmarks.¹ This inter-

active relationship dictates phonetics, esthetics, the closure path of the mandible, the steepness of the posterior anatomy, vertical dimension, and provides guidance to the closure position of the temporomandibular joint (TMJ).^{2(pp274-297)} An ideal TMJ position can be evaluated through splint therapy or bimanual manipulation.^{2(pp28-55)} The projected incisal edge position was determined visually with the aid of a flowable resin mock-up. After establishing the anterior incisal positions, the subsequent diagnostic waxing (Figures 1 and 2) for tooth placement was undertaken with consideration to golden proportion, arch form, cusp-to-fossa relationships, curve,

achieve desirable length-to-width ratios and golden proportions.^{3,4}

Based on the desired goals of the patient, both the soft and hard tissue may need modification. Often the patient denies orthodontic correction (as in the case presented here) (Figure 4). Fortunately, the periodontal interface may tolerate minor alterations to form and contour without osseous reshaping and the kind nature of all-ceramic restorations can have a positive effect on tissue health.⁵

Before the Procedure

After developing a sequence for treatment, the treating dentist should send information to the laboratory before the fabrication of a diagnostic wax-up. An impression and photographs of the resin mock-up are necessary. Photographs should include a close-up that shows the corners of the lips, a profile that shows the lower face, and a facial view showing the patient from chin to eyebrows (Figure 5). All photographs must include the patient's smile. This series of photographs should be taken of the preoperative condition as well as the mock-up. The



Figure 1—A diagnostic wax-up designed from an intraoral mock-up.



Figure 2—An occlusal view showing margin placement and changes to the arch form.



Figure 3—A full-view preoperative smile showing the corners of the lips.



Figure 4—A preoperative intraoral view from edge to edge.



Figure 5—A preoperative full facial view.



Figure 6—A preoperative photo with the stick-bite shows the incisal edges parallel to the interpapillary line.



Figure 7—The preparation of the lower cuspids to establish improved anterior guidance.



Figure 8—A preoperative photo (before anesthetic) was used to mark the midline with indelible pen to view the relationship of the philtrum.

authors prefer that impressions be taken of both arches using the same impression techniques used for the definitive restorations (not alginate) because the laboratory's accuracy is then greatly enhanced. A stick-bite parallel to the horizon and a full-face photo of the patient with the stick in place (Figure 6) serves as a leveling device in the laboratory.⁶

A face-bow for mounting the study models was also taken. Bite registrations of the initial jaw relationship and a centric relation position were captured using an anterior jig and an injectable bite-registration material. The final desired restorative position is based on the occlusal philosophy and educational background of the treating dentist. The authors believe in a combination of bimanual manipulation, splint therapy, and diagnostic model study to determine centric relation restorative position. This may require modifications by either posterior equilibration, tooth movement, or splint therapy.⁷ Final confirmation of functionality and esthetics is accomplished with provisional restorations.

Laboratory Diagnostic Sequence

Diagnostic waxing in the laboratory gives dentists the opportunity to learn a great deal about the subsequent treatment. The procedure must start with an additive/reductive process. By selectively reducing the stone model in areas that are beyond the desired contour and adding wax to areas that are deficient of the desired position, dentists can quickly achieve an ideal arch form. Further evaluation of the

teeth involved in this process allows us to deduce ideal marginal placement and preparation design to accomplish the treatment goals.

All casts were poured in the laboratory and based before mounting. The stick-bite was used to ensure proper orientation during trimming, thereby avoiding the optical illusion of models with nonparallel bases. Three sets of models were made. All of the models were mounted on a **Stratos® 200 (Ivoclar Vivadent®, Inc)** using the bite registrations provided.

The desired incisal edge position achieved with the resin mock-up was transferred to the first set of mounted models using a silicone matrix and wax injection. With the incisal edge position established, the next

cusps in the posterior, and proper overbite/overjet relationships should be achievable with the planned treatment or a change in treatment needs to be considered.

Once the incisal and gingival boundaries were established, wax was added and stone was removed to improve the esthetics. Consideration was given to golden proportions, length-to-width ratios, axial inclination, filling of the buccal corridor, thickness of the incisal edge, and lingual guidance. When a functional and esthetic result was achieved, all areas where stone was removed were marked in red. A silicone impression was taken of this model when completed. By observing areas covered in wax or marked in red, a strategy for marginal placement and preparation

ing the additive/reductive model into an all-wax presentation model with no loss of time. This final wax-up was cleaned and detailed before a silicone impression was taken, which was used to make the provisional restorations in the patient's mouth.

Preparation and Provisionalization

The diagnostic models, photographs, and mountings were used to plan a conservative treatment approach to gain esthetic, functional, and phonetic harmony. The communication protocol established by the authors led to predictable planning for the preparation, provisionalization, and fabrication phases of treatment. Using the diagnostic wax-up, preparations can be carefully orchestrated with reduction guides fabricated from sectioned putty matrices or the quick fabrication of provisionals made from a full-arch matrix of the diagnostic wax-up.

The patient's four mandibular anterior teeth were modified with enamelplasty without anesthetic to help harmonize anterior coupling. The two lower cuspids were prepared for two all-ceramic crowns because of severe rotation and the need for good cuspid guidance. The cuspids were prepared in accordance with the diagnostic wax-up under anesthetic (Figure 7).

The maxillary anterior midline was established by the relationship of the philtrum to the incisal papilla. Before anesthetic, an indelible marker was used to mark the intended position of the midline (Figure 8). The teeth were prepared with heavier

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step was to make any requested changes in gingival architecture. Beginning with the incisal edge position from the mock-up, wax was added to all of the incisal edges and cusp tips of the teeth to be treated to set up the smile line and buccal corridor. As a general rule of esthetics, the gingival plane should follow the curvature of the upper lip and the incisal plane should follow the lower lip. A preliminary functional evaluation should be conducted at this time. Anterior disclusion, canine guidance, clearance of the balancing side

design was developed.

The teeth to be treated were prepared on a second set of models using the margin placement and preparation design information that was gathered during the creation of the additive/reductive model. A duplicate of this prepared model can be used as a chairside visualization tool for the dentist while preparing the patient's teeth. The silicone impression taken of the first model was carefully fit over the prepared model and wax was injected through a small hole in the incisal edge, thus transform-



Figure 9—The initial preparations to move the midline to the right.



Figure 10A—The preparation to redirect the axial inclination.



Figure 10B—The occlusal view of the preparations showing modification of the right bicuspid.



Figure 11—The final preparation with the underlying shade stump.

reduction on the distals of the maxillary right bicuspid, lateral, and central. The mesial aspect of the upper left central, lateral, and cuspid was also heavily prepared to allow a shift to the left (Figure 9). The preparations were redirected with proper axial inclinations by proper rotary bur placement to direct the long axis distally in an incisopal direction^{8(p62)} (Figure 10A). The lingual natural tooth surface was preserved by the restorative planning of ceramic veneer coverage. The upper first bicuspid was prepared to be restored as a cuspid (Figure 10B). Incisal reduction was accomplished to facilitate a final length 1.5 mm shorter than the final projected diagnostic length.^{8(p246)}

All of the the external surfaces were rounded and care was taken to cause no tissue trauma. A retraction cord was not used because of the careful management of the preparation margins just at or below the sulcus. The final records, including underlying photographs of the preparations, the final impression, face-bow, and bite registration in centric relation were captured (Figure 11).

The goal of this systematic restorative approach was to achieve all form, function, and esthetic objectives with the provisional restorations, then transfer that information to the definitive restorations without losing information. With this in mind, a pressed ceramic restorative material was selected. In the authors' opinion, natural contour and proper orthodontic positioning are more visible from a greater distance and have much more impact than tooth color.

After achieving all of the goals of the case in the provi-

Case Study continued



Figure 12A—A retracted view of the provisional restorations.



Figure 12B—A full-smile view of the provisional restorations.



Figure 13—The model of the provisionals mounted to the lower preparation model.



Figure 14—The matrix of the incisal edge from the provisional model.



Figure 15—The final wax-up mimicked the provisional restorations.

sional restorations (Figures 12A and 12B), the greatest advantage to the pressed ceramic technique was the ability to accurately replicate the preexisting shapes. An accurate impression of the provisional restorations was sent to the laboratory along with the master impressions of the preparations. Model and die work was completed and stone casts were mounted with the face-bow and bite registrations (Figure 13). The stone model of the provisional restorations was also articulated. Die spacer and lubricant was placed on the dies of the prepared teeth. A silicone impression was taken of the provisional model. This impression was then carefully seated on the model of the prepared teeth and wax was injected into the impression of the provisional restorations to achieve the desired contour and position. Not only was this technique very time efficient, it accurately reproduced the provisionals, which were functionally and phonetically corrected to a proper incisal edge position (Figure 14).

Photographs of the provisionals were consulted as the final wax-up (Figure 15) was completed and any necessary small improvements were made. The wax restorations were then attached to a sprue base and invested. Burnout and ceramic

Case Study continued



Figure 16A—The amount of the incisal cut-back was evaluated in the matrix.



Figure 16B—The color of the underlying dentin was evaluated and the effect stains were applied.



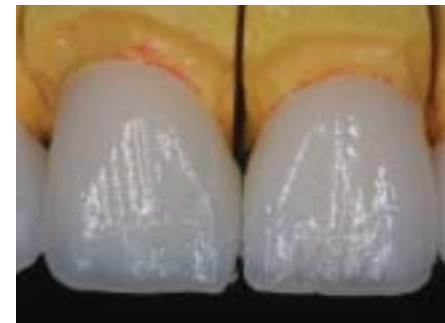
Figures 17A and 17B—The incisal effect porcelains were applied.



Figure 17C—The fired effects were evaluated.



Figures 18A through 18C—Opalescent enamel was applied and fired.



Figures 19A and 19B—An 850-012 diamond bur was used to finalize the contour.



pressing were then completed. The ceramic restorations were fit back to the master dies and contouring and surface morphology was finalized. At this stage, the pressed ceramic restorations had only one color and the translucency of porcelain. To achieve the translucency and shade variation of natural teeth, some of the pressed material was

removed (Figures 16A and 16B) and replaced with layered ceramic of the desired color and translucency. To ensure preservation of the already achieved incisal form and position, a silicone matrix was made before cutback of the incisal of the pressed restoration. This matrix then became a useful tool to the ceramist to visualize the appropriate locations for internal effects (Figures 17A through 17C) while the ceramist built the

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porcelain. Incisal porcelain of the desired translucency was used (Figure 18A and 18C) to reestablish the incisal edge position and form. Final surface contour and microanatomy were developed by using rotary diamond burs (850-012, Brasseler USA®) (Figures 19A and 19B). The restorations were then glazed and fit back to a solid model.



Figure 20A—A solid model revealed a small black triangle between teeth Nos. 8 and 9.



Figure 20B—The correction porcelain filled the black triangle.

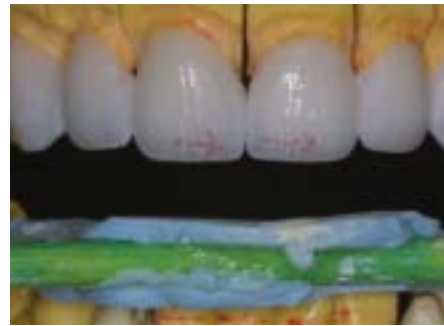


Figure 21A—A stick-bite was used to evaluate the midline.



Figure 21B—The corrections were made to the midline angulation.



Figures 22A and 22B—The final surface luster was achieved using rubber wheels and diamond polish.



Figure 23A—A retracted photo of the final restorations.



Figure 23B—Full-smile view of the final restorations.

Small corrections were made to close any interproximal spaces (Figures 20A and 20B) or reshape the incisal embrasures. The vertical midline was verified with the stick-bite and any necessary corrections were made (Figures 21A and 21B) only after checking the photograph of the stick-bite (Figure 6) to ensure that it was level. A diamond-impregnated rubber wheel followed by a diamond paste (Figures 22A and 22B) was used to achieve the desired reflective qualities.

Cementation

The final restorations were inspected for marginal fit and evaluated on the master dies. The patient was anesthetized, and the provisionals were carefully sectioned so that the underlying tooth structure was not damaged. The preparations were cleaned with a chlorhexidine scrub and each individual restoration was tried to check the marginal fit.

The use of ceramic contouring to close space from the lingual presents variations in marginal fit at try in. These contours can be modified and smoothed after cementation when the restoration is of much higher strength. All of the restorations were tried-in with try-in gel (Variolink® II, Ivoclar Viva-

dent®, Inc) to evaluate the desired final color and to check the interproximal contacts. After patient approval, each restoration was washed, etched with 37% phosphoric acid, silanated (RelyX™ Ceramic Primer, 3M ESPE), and dried. A rubber dam was placed, the teeth were isolated, etched for 15 seconds, and

Careful flossing of the interproximal area of the centrals ensures minimal finishing postcuring.

washed. While leaving the teeth moist, bonding agent (Single Bond, 3M ESPE) was placed and lightly air-dried. Both the facial and lingual surface were light-cured for 20 seconds. The internal surface of the left and right central restorations were painted with adhesive and lightly air-dried. The restorations were loaded with light-cured resin cement (Variolink® II white, Ivoclar Vivadent®, Inc), seated, held into place, and excess cement was cleaned off. Each restoration was tacked cervically at the midface of the individual restoration. Proper cleaning of

the distal surface is critical. Careful flossing of the interproximal area of the centrals ensures minimal finishing postcuring. The laterals and the cuspids were then cemented with the same technique. The restorations were light-cured for 2 to 3 minutes each. Final cement clean up followed by occlusal adjustments under water and final polishing were then completed.

The final restorations (Figures 23A and 23B) allowed tissue harmony, proper axial inclination, midline corrections, sound anterior guidance, and esthetic harmony. In addition, the right first bicuspid was contoured restoratively into a cuspid. ○

CONCLUSION

The success or failure of any restorative treatment is assured in the planning phase before any tooth is touched with a bur. By carefully working through the diagnostic process then using the gathered information during preparation and transferring that information through the provisionalization and final fabrication process, all gaps that could result in guesswork are filled. By following a systematic approach, the end result of treatment becomes a forgone conclusion, not an event anticipated with apprehension.

DISCLOSURE

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Product References

- Products:** Stratos® 200, Variolink® II, Variolink® II white
Manufacturer: Ivoclar Vivadent®, Inc
Address: 175 Pineview Drive
 Amherst, New York 14228
Phone: 800.533.6825
Fax: 716.691.2285
- Products:** 850-012 bur
Manufacturer: Brasseler USA®
Address: 1 Brasseler Boulevard
 Savannah, Georgia 31419
Phone: 800.841.4522
Fax: 912.927.8671
- Products:** RelyX™ Ceramic Primer, Single Bond
Manufacturer: 3M ESPE
Address: Bldg 275-2SE-03
 St. Paul, Minnesota 55144
Phone: 800.634.2249
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