A Systematic Approach to Predictable Esthetics Using Porcelain Laminate Veneers

Tal Morr, DMD, MSD*
Harald Heindl, MDT**

With the continual advancement in all aspects of dentistry, esthetics remains at the forefront for the patient. More than in the past, today's patients are much more educated about the treatment options available. This improved dental knowledge has developed as a result of the availability of information via the Internet, publications, and television. Because of this increase in knowledge, patients are now demanding the highest level of esthetics possible.

Although esthetics is certainly crucial, the ultimate objective for any dental treatment should be to restore health, function, and beauty using the most conservative method of treatment available to achieve the desired result. Bonded ceramic veneers are often the restoration of choice from a biologic, functional, mechanical, and esthetic standpoint when the objective is to modify tooth position and/or tooth form, close diastemata and/or cervical embrasures, or change the color of teeth. All of these options are approached with the assumption that enough enamel substrate is available and that the patient does not wish to undergo orthodontic treatment.

The natural tooth is uniquely made up of two materials: enamel and dentin. The rigidity of enamel and the flexibility of dentin create the unique complex of the tooth crown. Studies have shown that from a mechanical and functional standpoint, feldspathic porcelain veneers adequately restore the rigidity of the crown when used as an enamel substitute.[1,2] From a biologic standpoint, we know that, because of their esthetic qualities, bonded veneers do not require penetration into the gingival sulcus in every clinical situation. This may prevent potential damage to the periodontal tissues.[3] Because plaque and bacterial vitality have been found to be significantly reduced around porcelain veneers,[4] these restorations may be biologically beneficial to patients with poor oral hygiene. Porcelain has been found to be less susceptible to accumulation of bacterial plaque than mineralized tooth structure, gold, and composite resin.[5,6] Because porcelain veneers have no metal substructure, they allow light to be absorbed, deflected, and reflected in a manner similar to natural tooth structure. By contrast, in a restoration with a metal substructure, light traverses the ceramic but is blocked by the metal core, all too often with a resultant graying effect of the definitive restoration.

*Private practice, Aventura, Florida, USA.
**Aesthetic Dental Creations, Mill Creek, WA, USA.
Correspondence to: Dr Tal Morr, 20760 West Dixie Hwy, Aventura, FL 33180, USA. Fax: 305-935-6753. E-mail: info@tmprosthodontics.com and HaraldHeindl@hotmail.com

As with all restorative procedures, a thorough diagnosis and treatment plan must be implemented with communication occurring between all members of the treatment team.[7] The initial evaluation should encompass visualization of the final esthetic alterations within the mechanical and functional parameters. An esthetic interpretation of the final result will help to shape the treatment plan in relation to proposed changes in tissue level, contour, tooth form and arrangement, and preparation design and will enable the team to achieve the final result.

CASE 1

Esthetic Evaluation

A 28-year-old female, who was a model, presented for esthetic improvement of her smile. Her chief complaint was that her teeth were too round and she was told that they did not reflect light appropriately; hence, she was asked to pose with her lips closed during photo shoots. The patient was emphatic about having a long-term esthetic result that would not stain and discolor as did her composite resin restorations. Before a determination could be made about the treatment modality to be used and the number of teeth to be restored, a thorough esthetic evaluation was performed.

The patient was asked to say "M" letting her lips relax naturally (Fig 1a). With the patient's lips at rest, the incisal edge position of the central incisors was evaluated; the position of the maxillary right central incisor appeared to be appropriate for the patient in terms of age and gender.[8] Some problems became evident when the patient smiled, however (Fig 1b). The left central incisor was slightly shorter than the right central incisor. Both canines were slightly worn and were too short in relation to the occlusal plane drawn from the right central incisor to the molars. Lengthening of the canines would level the occlusal plane.

The rotation of the maxillary left canine created severe disharmony in the smile, its distal aspect being more prominent than the mesial. A key element of esthetics is that, from a facial point of view, it is preferable to see the mesial aspect of the canine only. This helps to create the transition from the anterior of the mouth to the posterior. The canine is the tooth that defines the arch form, whether square, u-shaped, or v-shaped.

Also noted in the examination was the axial inclination of the maxillary left lateral incisor. Rather than appearing to be tipped toward the mesial from a cervicoincisal direction, it was tipped distally. This in turn created imbalance in the smile line. There was also an obvious discrepancy in the balance of the gingival levels (Fig 1c). Ideally, dental professionals prefer the gingival margins of the central incisors and canines to be at the same level while the lateral incisor tissue heights should be somewhat more coronal. Although the soft tissue on both centrals was even, it was more coronal than that of both canines. The gingival tissue around the maxillary left lateral incisor accentuated the problem by being more cervical to that of the centrals, and the soft tissue around the left canine was more cervical than that of the right canine.

Another key element that the patient wanted to address was the diastema (Fig 1d). An attempt had been made at some point to close the diastema with composite resin, but at the initial presentation, the composites were discolored and worn. In addition, the central incisors appeared to be too narrow relative to the lateral incisors and canines.

From the esthetics evaluation, it was determined that soft tissue correction would be necessary to create a more harmonious result. As part of the evaluation, a local anesthetic was administered and the facial aspects of the two central incisors were probed to determine the location of the cementoenamel junction. Approximately 1.5 mm of the crowns (enamel) of the central incisors and the right lateral incisor were covered by the gingiva. The bone was sounded, and the biologic width for this patient was found to be about 2.5 mm. This determination would be helpful for bone recontouring. From a mechanical and functional point of view, all other findings were within normal limits.

Esthetic Treatment Plan

The problems were discussed with the patient, and the objectives for restorative treatment were laid out as follows: *(1)* to surgically level the soft tissue to create a balanced and harmonious gingival plane and accompanying tooth length and shape, while maintaining the cervical aspect of the preparation in enamel; *(2)* to close the diastema between the central incisors so that these teeth would appear more dominant; *(3)* to correct the axial inclination of the teeth so that from a cervicoincisal direction they would appear to be tipped toward the mesial; and *(4)* to bring the maxillary right canine more buccal, lengthen both canines slightly, and rotate the maxillary left canine so that it would transition from anterior to posterior and create a more harmonious arch form. It is important to note that when severe manipulation of the position of the teeth is necessary, some dentin exposure will result during the preparation.

Porcelain veneers are an ideal restoration for this type of treatment if the objective is to change the size, contour, arrangement, and color of the teeth. Not only are they the least invasive type of restoration, other than composite bonding, but they can fulfill all of the objectives of treatment. Composite restorations were not an option because of their inherent problems with staining and degradation over time. If the objective had been only to correct tooth alignment and the diastema, orthodontics would have been the treatment of choice.

Diagnostic Waxup

Alginate impressions of the maxilla and mandible were made, and models were mounted using a facebow leveled with the eyes. A diagnostic waxup of all the proposed changes was made on the cast (Fig 2). The diagnostic waxup is the most critical step for predictability in any type of restorative procedure. Not only does it allow visualization of the final proposed changes, it also reveals whether the desired changes are reasonable and able to be achieved. In this case, the facial surfaces of the central incisors were ground down slightly on the diagnostic cast to make them less rounded, and the distal of the left canine was modified to allow correction of the rotation prior to the waxup. Knowing how much was ground off helps tremendously in the preparation step.

The incisal edges were waxed first, followed by the facial contour, and then the tissue heights were corrected by waxing over the gingival margins where necessary to level the gingival plane. The waxup enabled the future tooth preparation design and soft tissue leveling to be visualized.

Soft Tissue Leveling and Contouring

The patient returned for surgical crown lengthening. A modified approach to the technique, as described by Eriks,[9] was used. A papilla-preservation flap was elevated, and the bone was contoured to be at the same level on both the canines and the centrals, taking into consideration the incisal edge positions. The bone on the maxillary right lateral incisor was leveled with that of the maxillary left lateral. As mentioned earlier, a biologic width of 2.5 mm was found when sounding to bone. This measurement was used to position the bone according to the final position of the marginal tissue as determined by the waxup. Care was taken not to create a situation in which the dentin would be exposed. Because of this, the centrals were left somewhat shorter than the canines, and the laterals were not leveled perfectly. More aggressive crown lengthening would have exposed dentin.

After 3 months of healing, the smile already revealed a harmonious improvement (Fig 3a). The biologic width was evaluated again for maturation by sounding to bone. When the measurement equaled 2.5 mm, it was deemed ready for preparation. It was noted at this time that the tissue heights of the central incisors were not level even though the bone had been carefully placed in the correct position (Fig 3b). It is possible that some remodeling of the bone around the left central incisor occurred.

Second Diagnostic Waxup

Because the soft tissue was surgically corrected, a second diagnostic waxup was necessary. A new alginate impression of the maxilla was made, and the cast was mounted against the mandibular model.

Using silicone indices, the tooth contours of the original waxup were duplicated on the postoperative maxillary cast with the corrected gingival levels and contour. Now that the central incisors were longer, they could be made wider and more dominant. A full-coverage silicone index of the waxup was made, extending beyond the facial and palatal margins and from second premolar to second premolar (see Fig 6a). This would be used for fabrication of the provisional restorations. A facial index was also fabricated to be used for verification of precise reduction of the preparations in the facial plane (Fig 4).

Tooth Preparation

The patient was given local anesthetic, and the preparations were begun. Current techniques suggest using a depth-defining bur to ensure proper reduction, which is 0.3 to 0.7 mm for porcelain veneers.[10] If the teeth to be veneered are properly aligned and no major changes in tooth form are required, this type of technique is useful. On the other hand, when changes in tooth form and alignment are required, a more precise technique is needed, one that will take into consideration the final shape and contour of the veneers. In this case, a facial silicone index was beneficial in guiding the preparation depth and design (see Fig 4). Knowing how much stone was removed from the cast to create the tooth contours was also beneficial. All waxups were prepared by the restorative dentist since he was responsible for evaluating and determining the final changes. Preparations were begun by removing the existing bonding and then opening the proximal surfaces using diamond disks. The latter technique facilitates preparation of the proximal surfaces, impression making, and laboratory procedures. Because one of the objectives was to close the diastema and the cervical embrasures, the preparations needed to be continued to the palatal aspects of the teeth interproximally as well as subgingivally to allow for a smooth emergence profile of the veneers. Interproximal preparation is also necessary for alteration of the position and rotation of a tooth.

Once the teeth were disked, Ultrapak 000 cord (Ultradent, South Jordan, Utah) was placed interproximally within the sulcus. The teeth were prepared again so that they finished at the level of the tissue facially and at the level of the cord interproximally (Fig 5). The facial matrix was used to ensure proper reduction of the facial and interproximal aspects of the teeth. Cervically, the preparations were left in enamel. Under normal circumstances, the preparations would be cut to the tissue level when little or no alterations in color are needed. In this case, the soft tissue of the left central incisor was more cervical than that of the right central incisor following surgical correction, even though bony placement during surgery was carefully measured with a caliper. If the bone was placed in the correct position, then the tissue should eventually move down to the desired position. Because of this, the cervical extent of the preparation on the left central incisor was made by carefully measuring the preparation on the right central incisor so that the teeth would be the same length, even though tooth structure remained cervical to the preparation. Once the preparations were finished, a laser was used interproximally to modify the cervical contour of the tissue (see Fig 5).

Provisionalization

Once the preparations were finished, the full-coverage matrix of the waxup was filled with Alike temporary resin (GC America, Alsip, IL) and placed in the mouth (Fig 6a). The matrix with the resin inside was gently pumped up and down until the resin set (Fig 6b). The provisional restorations were then finished with burs and disks after evaluation in the mouth, and any necessary contour

CASE 1 (Figs 1 to 11)

Fig 1a Initial presentation of lips at rest.

Fig 1b Initial smile.

Fig 1c Initial intraoral frontal view.

Fig 1d Closeup of maxillary anterior teeth showing diastema and discolored composite resin restorations.

Fig 2 Diagnostic waxup of proposed changes.

Fig 3a Smile after esthetic crown lengthening.

Fig 3b Intraoral view of soft tissue after esthetic crown lengthening.

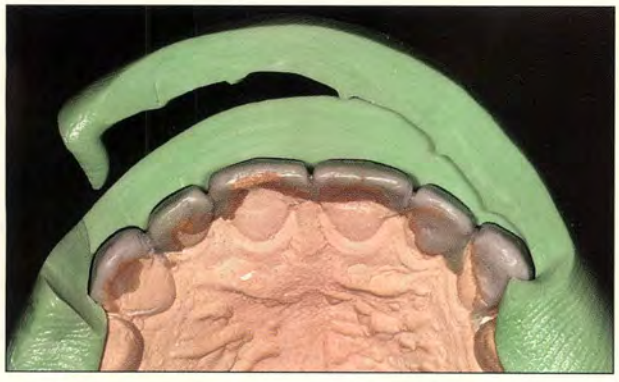

Fig 4 Facial matrix made from the waxup model.

Fig 5 Final tooth preparations.

changes were made by either addition or subtraction of acrylic resin. At this point, interproximal shape was modified to close the cervical embrasures and to shape the cervical contour of the tissue. Once the final contours were achieved, the provisionals were removed and measured individually from the cervical extent to the incisal edge to verify correct reduction. Any areas that were not reduced enough were corrected by modifying the preparation.

With every provisional fabricated from a waxup, some modification is always needed in the mouth. The waxup is prepared without the face to provide context. The final contours must be corrected in the mouth to obtain a true visualization. Only after the provisionals are properly contoured can it be determined if the preparations were made correctly (Figs 7a and 7b).

Once the preparations were deemed completed, a second cord, Ultrapak 00 soaked in a 20% aluminum chloride gel (Styptin, Van R Dental, Oxnard, CA), was packed into the sulcus to retract the tissue for final impressions. Small cords are generally used for veneers because, if there are no alterations in the tooth color, a supragingival margin, or one made to the tissue level, is adequate. As always, the final objective is to have gingival health at the periodontal-restorative interface. Final impressions were made using a polyvinyl siloxane material (Affinis, Coltene Whaledent, Mahway, NJ).

Photographs

Color photographs of a shade guide with the original teeth and the tooth preparations were taken to allow the technician to see the underlying tooth color. This is essential to inform the technician if any blockout is needed to achieve the desired shade (Figs 8a and 8c). A black-and-white photograph was also taken to allow evaluation of the desired value versus the shade tab (Fig 8b).

Provisional Cementation

The provisional veneers were cemented with resin and no bonding agent. There is generally enough friction to hold them in place because of the interproximal preparation. If friction is limited, spot etching and bonding with a resin can be used to aid in the retention. The initial cord used for preparation was left in the sulcus until after the provisionals were cemented.

Alginate Impressions

Once the provisionals were cleaned, alginate impressions were made of the provisionals and the opposing arch. Because the lingual aspects of the anterior teeth were not altered, no occlusal record was needed.

Laboratory Considerations

Three casts were made from the final impression with type IV dental stone. The first pour was kept as a solid cast, the second was used for fabrication of a saw-cut working model, and the third was used for final control dies. The DVA (Dental Ventures of America, Corona, CA) model system was used for the working model. This system provides duplicate molds for single teeth and exchangeable, heat-resistant, aluminum oxide pins for the refractory dies. The dies were sealed with a thin-bodied cyanoacrylate, and one layer of die spacer was applied to the surface. The prepared dies were then duplicated using a polyvinyl siloxane material (Doubletake, Ivoclar Williams, Amherst, NY). Refractory dies were fabricated from this impression.

Once all the casts were ready, the working model and the solid cast were cross-mounted with the provisional model for reference. From the cross-mounted provisional model, four types of indices were made. The first was a full-coverage index (Fig 9a) cut into vertical segments. This was

used to verify the available space for porcelain layering, the labial curvature of the provisionals, and the length of the planned restoration. The next index fabricated was the labial index (Fig 9b) cut into horizontal segments. This index showed the labial separations between the teeth, the position of the line angles, and most importantly, the width of the desired final tooth form. A third index was made from the palatal (Fig 9c) aspect. This index was used to establish the correct length of the dentin body, the placement and position of the internal effects, and the final length of the restoration. The fourth index was made by imprinting the incisal edge (Fig 9d). This index was used as a precautionary measure to ensure proper incisal edge position during the buildup process. By opening the pin 1 mm and building up the ceramic to the incisal index, the restorations should be either slightly long or perfect in length after porcelain shrinkage occurs.

After all of the indexes were made, the veneers were built up on the refractory dies, checked on the master dies, and adjusted on the solid cast. The internal aspect of the veneers were then etched with 9.5% hydrofluoric acid for 5 minutes and delivered to the restorative dentist.

Final Cementation

At delivery, the health and beauty of the soft tissue form was evident. This was developed by the preparation design, the precise fit of the provisionals, and meticulous oral hygiene by the patient (Fig 10). These elements are essential for final cementation of the veneers. The only way to achieve a healthy soft tissue is by atraumatic manipulation of the gingival tissues throughout the restorative phase of treatment (preparation, retraction, provisionalization, and final cementation).

A local anesthetic was administered followed by removal of the provisionals and scaling of the resin from the teeth. The sulcus was packed with Ultrapak 000 cord soaked with the same hemostatic agent used previously. The cord serves many purposes: it allows retraction of the tissue from the preparation margin, aids in moisture control, provides hemostasis, and helps in the final cleanup of excess cement.

The veneers were tried in first to evaluate the interproximal contacts. Articulating paper was used to verify the contacts, and adjustments were made with a diamond-impregnated wheel where needed. The esthetics were then evaluated with the patient by placing water in the veneers and seating them in the mouth. After the patient approved them, the veneers were re-etched with a 9.5% buffered hydrofluoric acid (Ultraetch, Ultradent) for 3 minutes and placed in the ultrasonic cleaner for 5 minutes to remove any residue. They were then silanated with ScotchBond ceramic primer (3M Dental Products, St Paul, MN), and a layer of bonding agent was applied to the surface and the excess blown off. The preparations were cleaned with pumice, rinsed, and etched with 32% phosphoric acid (3M). Bonding agent was applied to the moist tooth surface (Single Bond adhesive, 3M), and the veneers were cemented with RelyX veneer luting cement (color B0.5/white, 3M). Excess cement was removed initially with a brush and the contacts cleaned with floss after 3 seconds of light curing. Removal of the cord and final cement cleanup were performed after the veneer margins were covered with Deox, an oxygen-barrier solution (Ultradent) and light cured adequately.

After 2 weeks of healing, the patient presented for final photographs. It was evident that all of the desired objectives were achieved (Figs 11a to 11f). The soft tissue was leveled to create a balanced and harmonious gingival plane; tooth arrangement and contour were improved, as was the occlusal plane; the diastema was closed; the axial inclinations of the teeth were improved to provide harmony; and the maxillary left canine was derotated to create a smooth transition between the anterior and the posterior aspects of the arch.

The veneers are biologically, mechanically, functionally, and esthetically sound.

6a

6b

Fig 6a Full-coverage silicone matrix with acrylic resin prior to placement in the mouth.

Fig 6b Full-coverage silicone matrix after acrylic resin has set.

7a

7b

Figs 7a and 7b Smile and intraoral view of provisional veneers on the tooth preparations. Note the exposure of dentin beyond the margin of the provisional of the left central incisor.

Fig 8a Color photograph of the teeth at initial presentation with B1 shade tab.

Fig 8b Black-and-white photograph used for evaluation of the value of the teeth relative to the shade tab.

Fig 8c Photograph of the tooth preparations with B1 shade tab.

9a

9b

Fig 9a Full-coverage index used to evaluate facial reduction.

Fig 9b Labial index used to evaluate both the labial separation between the teeth and the width of the proposed veneers.

9c

9d

Fig 9c Palatal index used to establish correct length and internal effects of the porcelain.

Fig 9d Incisal index used to ensure proper incisal edge position during the porcelain buildup.

Fig 10 Tissue health at delivery of the final restorations, after removal of provisionals.

Fig 11a Final incisal edge position with lips at rest.

Fig 11b Final smile.

10

11a

11b

Figs 11c and 11d Final intraoral views. Note that the tissue level around the left central incisor is almost level relative to that of the right central incisor.

Fig 11e Right lateral view of veneers.

Fig 11f Left lateral view of veneers.

CASE 2

Esthetic Evaluation and Treatment Plan

A 34-year-old man presented with two existing veneers. His chief complaint at the time of treatment was the difference in the color of the two veneers. He was also unhappy with the embrasure that was developing between the teeth and the darkness at the junction of the maxillary right veneer and tooth (Figs 12a to 12c).

A thorough esthetic evaluation was performed as described for case 1. The soft tissue profile was deemed acceptable. The necessary correction was localized to the central incisors. As with case 1, predictability even with only two teeth is achieved by determining the objectives for treatment. In this case, the objectives were *(1)* to reshape the maxillary central incisors to mimic natural contours and optical qualities; *(2)* to close the cervical embrasure between the central incisors to create balance in the soft tissue; and *(3)* to make the junction between the tooth and veneer invisible.

Veneers were clearly the restoration of choice for improvement of the patient's esthetic concerns.

Waxup

As with case 1, a waxup was prepared to obtain the desired corrections in contour, size, and tissue form (Fig 13). When waxing to close a cervical embrasure, facial line angles help define the final contour of the teeth. The line angles give the illusion that the teeth are tapering even though the actual tooth form may be more square as a result of the lengthened contact. Embrasure closure is obtained from the palatal aspect of the restoration. Indexes were made from the waxup as in case 1.

Preparations

Ultrapak 000 cord was packed into the sulcus after locally anesthetizing the area. The teeth were prepared based on the changes made on the model and the waxup and with the use of the facial index. Preparations were extended to the palatal aspect and intrasulcularly to allow room for a smooth emergence and embrasure closure (Fig 14). As in case 1, a full silicone index was used to fabricate the provisionals. The provisionals were removed and contoured using acrylic burs and a variety of disks. Once the desired contours were achieved, the smile was evaluated for harmony and balance by the clinician and the patient (Fig 15a). The cervical contact point was carried just above the papillary level. When soft tissue is manipulated from an intrasulcular position, a small interproximal space must remain for coronal movement of the papilla, which occurs with lateral pressure from the provisional.

The provisionals were measured for adequate preparation depth (Fig 16), and any needed adjustments were made. Preparation was aimed at finishing in enamel; however, not only does removal of old veneers make this difficult, but in this case, the preparations were already partly in dentin. An explorer was used to determine when the existing porcelain and composite had been removed.

Final Impressions and Photographs

Once the provisionals were made and the preparations were acceptable, a second cord (0) was placed into the sulcus. Final impressions were made using a polyvinyl siloxane impression material. Photographs were taken of the preparations and the adjacent teeth with shade tabs. These were done both in color (for color comparison) and black and white (to compare value).

Provisional Cementation

As in case 1, the first cord was left in the sulcus. The provisional veneers were cemented with resin cement with no bonding agent. Because the preparations were parallel, there was enough fric-

CASE 2 (Figs 12 to 22)

Fig 12a Initial smile.

Fig 12b Initial intraoral view.

Fig 12c Closeup of existing veneers on the central incisors. Note the exposed margin on the distal aspect of the right central incisor and the cervical embrasure.

Fig 13 Waxup of the proposed changes.

Fig 14 Final preparations for veneers with retraction cords in place, ready for impression.

15a

15b

Fig 15a Smile with provisionals.

Fig 15b Closeup of provisionals. Note the closure of the cervical embrasure and tissue recontouring.

Fig 16 Measuring the thickness of acrylic resin to ensure proper reduction of the preparations.

16

tion to hold the provisionals in place. As an added precaution, alginate impressions of the provisionals were made, and a vacuum-formed appliance that the patient would wear was fabricated to help hold the provisionals in place. The cords were removed after the composite was light cured.

Alginate Impressions and Laboratory Considerations

Alginate impressions of the provisional model and the opposing arch were made for cross mounting. No occlusal records were made. The impression was treated as in case 1 and was cross-mounted with the provisional model. All the same indices were fabricated to maintain predictability.

Ceramic Buildup

Porcelain layering was carried out using d.SIGN (IPS d.SIGN, Ivoclar Vivadent, Amherst, NY). The first layer was made using d.SIGN margin material applied in a thin layer up to the margin. This layer seals the refractory die and provides a secure bond between the porcelain and refractory material. The initial ceramic layer was a modified deep dentin placed on the incisal and interproximal areas to prevent excessive light absorption into these areas and to help smooth the transition from the incisal edge of the prepared tooth to the porcelain (Fig 17).

Three different types of dentin were used (Fig 18). Incisally, a modified dentin was used to enhance the brightness and value. Regular dentin was used in the center of the tooth. A blend of dentin and transparent was used on all areas where the preparation ended to allow the color of the underlying tooth to influence the color of the restoration. The length of the ceramic buildup was checked with a palatal index prior to cutback for enamel/translucent layering. In contrast to other ceramic materials, the dentin of the d.Sign system is so translucent that it is possible to apply internal effects directly onto the dentin. It is not necessary to apply those effects on the enamel wall.

The final form was developed in alternating increments of various enamels and translucents (Fig 19). A second bake is usually necessary to optimize form and contours. Quite frequently, interdental deficiencies, such as blunted interdental papillae, unfavorable tooth morphology, or diastemata, require an artificial closure of the interproximal spaces. In these cases, the interproximal contacts are overcontoured in the second bake. Once baked, the contact point is modified so it begins just above the position of the retracted papilla and ends near the incisal edge. Creating such a long contact area can cause an unnatural appearance to the tooth form. It is necessary to maintain the natural tooth form by emphasizing the triangular line angles and making the proximal contacts more toward the palatal aspect to give the illusion of reality.

Final Contouring and Finishing

The final contouring and surface texturing were carried out using a variety of diamond burs and green stones. Final tooth surface contour must be achieved prior to elaborating the surface texture. Use of silver powder applied directly to the surface helped to visualize the final contours and surface texture (Fig 20). Final surface treatment was completed with a quartz-infiltrated nylon wheel (Upofix Austenal, York, PA) and an oven glazing cycle without a vacuum. Mechanical polishing with pumice and a felt wheel is optional.

The dies were removed from the veneers, and the veneers were cleaned with 30-µm glass beads. The definitive restoration margins were checked on the master dies. Contours and interproximal contacts were confirmed and adjusted on a solid cast, both with and without the soft tissue model material in place (Fig 21).

Fig 17 Modified deep dentin layer to smooth the transition between the incisal edge of the preparation and the porcelain.

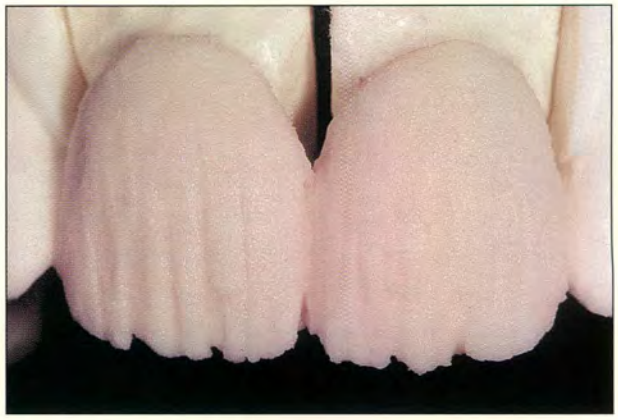

Fig 18 Dentin buildup.

Fig 19 Enamel and translucent buildup.

Fig 20 Silver powder to help visualize the final contours and surface texture.

Fig 21 Definitive restorations on the solid cast.


Figs 22a and 22b Final smile showing improved esthetics. The black-and-white photograph shows the value of the veneers relative to the adjacent teeth.


Figs 22c and 22d Frontal views of the final restorations.

Fig 22e Closeup of the veneers on the central incisors. Note the undetectable margins and closure of the cervical embrasure.

Final Cementation

The teeth and the veneers were treated and cemented as in case 1. One week after final cementation, tissue health and soft tissue embrasure closure from the papillae were evident, and the restoration margins were clinically undetectable (Figs 22a to 22e).

CONCLUSION

Following a step-by-step protocol is crucial to achieve predictability in any restorative case. Only through a meticulous process can success be consistently insured. The clinician's initial evaluation is imperative for success. Clinical cases must be evaluated from structural, biologic, functional, and esthetic standpoints. Not only does the initial evaluation enable the clinician to identify what alterations must be made, but it also helps in the formulation of the treatment plan needed to achieve the desired result. Treatment planning can only be verified by using the diagnostic contours cast, and only through this procedure can one truly tell if the proposed changes are possible. From the development of the proposed contours, reduction templates can be made to aid in correct preparation depth and design, to guide the surgeon as to the required soft tissue contours, and to directly fabricate the provisional restorations.

The provisional restorations are the only way for the clinician and patient to visualize the outcome within the natural frame of the face and mouth. When the provisional is correctly contoured, the soft tissue can be manipulated and shaped appropriately. A final esthetic tooth form and arrangement of the veneers is more consistently achieved by correctly cross-mounting a cast of the provisional restorations with the casts of the actual tooth preparations and using the information gathered from the various templates and indices. The final shade of the restorations can be predictable when the clinician supplies photographs of teeth and preparations for both shade and characterization and when the laboratory technician has a thorough understanding of ceramic layering. Throughout the treatment process, atraumatic manipulation of the soft tissue during tooth preparation, adequate provisionalization of the teeth, and careful cementation are essential if a healthy gingival response is to be achieved.

REFERENCES

1. Magne P, Douglas WH. Cumulative effect of successive restorative procedures on anterior crown flexure: Intact vs veneered incisors. Quintessence Int 2000;31:5–18.
2. Reeh ES, Douglas WH, Messer HH. Stiffness of endodontically treated teeth related to restoration technique. J Dent Res 1989;68:1540–1544.
3. Calamia JR. Clinical evaluation of etched porcelain veneers. Am J Dent 1989;2:9–15.
4. Kourkouta S, Walsh TT, Davis LG. The effect of porcelain laminate veneers on gingival health and bacterial plaque characteristics. J Clin Periodontol 1994;21:638–640.
5. Chan C, Weber H. Plaque retention on teeth restored with full ceramic crowns: A comparative study. J Prosthet Dent 1986;56:666–671.
6. Koidis PT, Schroeder K, Johnston W, Campagni W. Color consistency, plaque accumulation, and external marginal surface characteristics of the collarless metal ceramic restoration. J Prosthet Dent 1991;65:391–400.
7. Narcisi EM, Culp L. Diagnosis and treatment planning for ceramic restorations. Dent Clin North Am 2001;45:127–142.
8. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent 1978;39:502–504.
9. Eriks RE. A predictable approach for enhanced aesthetics: A case report. Pract Periodontics Aesthet Dent 1997;9: 229–231.
10. Touati B, Miara P, Nathanson D. Esthetic Dentistry and Ceramic Restorations. London: Martin Dunitz, 1999.