Minimal Veneer Intervention for Maximal Smile Transformation

Executing Patient Criteria with Imperceptible Esthetics

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Abstract

A variety of communication techniques and tools have been introduced to facilitate enhanced, more accurate, and more detailed communication of smile makeover case requirements between the dentist and laboratory technician. However, tools and techniques—including digital smile designs and digital shade analysis—also can be used to identify and review specific patient requests for treatment and demonstrate potential successful outcomes. This article presents a case in which the use of communication techniques and technologies among the entire team enabled a minimally invasive smile transformation with lithium disilicate veneers for a female patient.

Key Words: lithium disilicate, anterior veneers, smile design, smile makeovers, treatment planning

Figure 1: Preoperative full-face 1:10 frontal view.

Figure 2: Preoperative retracted 1:2 frontal view.

Figure 3: Preoperative retracted 1:1 frontal view of the maxillary anterior teeth.

Introduction

The importance and significance of communication between the dental office and laboratory for ensuring successful outcomes in cosmetic restorative dentistry is well acknowledged.[1,2] To facilitate enhanced, more accurate, and more detailed communication of case requirements between the dentist and laboratory technician, a variety of techniques and tools (e.g., real-time consultations, digital shade analysis and smile design) have been introduced. By incorporating proper and thorough communication, the restorative team can carefully plan cases to realize a patient's desires, which is of paramount importance in achieving a successful outcome.[1,2]

Therefore, it also is imperative that communication with the laboratory reflect the product of equally detailed communication and treatment planning between the dentist and patient.[3] Fortunately, the same tools and techniques that enhance dentist/laboratory communication can be used to identify and review all patient requests for their smile makeover. They also can be harnessed to demonstrate to the patient the clinical steps/treatment sequence or path to the final outcome necessary to achieve success for their case.

This article presents a case in which a female patient requested a minimally invasive (i.e., the fewest possible number of procedures and the least treatment time), natural-looking smile makeover to correct her chief complaint of gaps between her uneven maxillary anterior teeth. The use of communication techniques and technologies among the entire team—dentist, patient, and laboratory technician—enabled a minimally invasive treatment that resulted in a maximum smile transformation with lithium disilicate veneers.[4]

Patient Complaint and History

A 34-year-old female presented with chief complaints about her uneven anterior teeth and the gaps between them, specifically teeth #6 through #11 **(Figs 1 & 2)**. She greatly disliked her chipped central incisors **(Fig 3)**, as well as the axial inclination of her teeth and the size discrepancy of her upper lateral incisors. She was also extremely unhappy with the appearance of the old porcelain-fused-to-metal (PFM) crown on tooth #30, which exhibited noticeable shade value and contour discrep-

ancies when she smiled fully and broadly. The patient requested a very natural and realistic cosmetic smile makeover with indirect restorations on her anterior maxillary teeth to create "even" upper incisors, in addition to a new restoration to replace the old PFM crown on #30.

Evaluation, Diagnosis, and Treatment Plan

A comprehensive examination was performed. In addition to the axial inclination, size, and other issues that the patient identified with #6 through #11, these teeth also exhibited notable craze fracture lines, and there were incomplete fractures on #6 and #11. Old and failing composite resin restorations were observed on #7 through #10. The failing PFM at #30 exhibited open margins.

Additionally, the gingival zeniths of #7 and #10 were asymmetrical. Other gingival contours, zeniths, and positions were proper and her gingival health was well maintained. There was no bleeding on probing, nor any issues with inflammation in the entire anterior esthetic zone. The patient's oral hygiene and home care habits were good, and she maintained routine periodontal maintenance and reported flossing daily. Her buccal corridor was acceptable, without collapse.

Several treatment options—including clear aligner orthodontic therapy—were discussed with the patient, with the benefits, risks, and prognoses of each clearly outlined. The patient indicated that she understood her options, and she declined treatment with orthodontics due to the timeframe required and her desire for an "instant" smile makeover. She also emphasized that treatment must be as conservative as possible, and that she wanted her new smile to be natural and "believable."

Preliminary impressions were taken and models made, and preoperative photographs were also taken. Tooth shades and translucency intensity were determined using digital technology (MicroShade [MicroDental Laboratories; Livermore, CA] powered by ShadeWave [Issaquah, WA] technology) and captured in a photograph **(Fig 4)** and computer shade mapping **(Fig 5)**.

Additionally, the patient participated in discussions about, and digital smile design planning (Macstudio MicroSmile) of, her proposed treatment **(Figs 6 & 7)**. Significant time was spent with the patient addressing tooth contours, texture, anatomy, and lobing, as well as the overall silhouette of her final smile goal **(Fig 8)** using several digital tools (Macstudio smile catalog, and anterior characterization charts, MicroDental). Conversations and digital mock-ups also addressed tooth shades, intensity, and volume of translucency for her proposed treatment. This enabled the patient to specify that she wanted the cervical third of her restorations to have a " blended darker shade" (i.e., lower-value cervical third) and a polychromatic, natural-looking overall effect.

The gingival asymmetry created by the unharmonious zeniths of the patient's lateral incisors also was discussed during the digital smile design process and she was offered surgical options to address the biologic width considerations. However, she decided to maintain the existing gingival position and architecture (i.e., the approximately 1-mm asymmetry noted at the zeniths was acceptable to the patient), to keep the entire restorative process as minimally invasive as possible.

The records and digital plans were forwarded to the laboratory for use in discussing and planning the patient's treatment and, most importantly, for fabricating a diagnostic wax-up **(Fig 9)**. The basis for the wax-up was the detailed communication about the patient's desires and goals and, in particular, her signed paperwork approving the anterior characterization guide for translucency volume and intensity, lobing, texture, and smile catalog.

The wax-up was created to the patient's specifications and mounted on a semi-adjustable articulator (Stratos 100, Ivoclar Vivadent; Amherst, NY). The technician also created two putty stents (Sil-Tech, Ivoclar Vivadent). One was based on the digital smile design and would be used as a preparation guide, specifying exactly where tooth reduction would be required. The detailed digital smile design was multi-colored and designed for accurate communication between the dentist and laboratory technician. The other putty stent would be used for creating provisional restorations to enable the patient to experience a "trial run" of her smile decisions and provide an opportunity for her to request any final changes prior to fabrication of the definitive restorations.

The definitive treatment would involve six maxillary anterior lithium disilicate veneer restorations (IPS e.max Press, Ivoclar Vivadent).[5-7] Additionally, the failing PFM restoration at #30 would be replaced with a metal-free, highly esthetic and durable full-coverage lithium disilicate crown restoration (IPS e.max). However, the protocol discussed in this article focuses on the maxillary anterior veneer restorations.

The patient gave informed consent at every stage and was extremely pleased to have the opportunity to provide so much input into the decision-making process. She also appreciated the time taken to carefully map out her desires and review all the steps/sequencing for her treatment.

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Figure 4: A preoperative photograph with shade tab was taken for digital shade mapping.

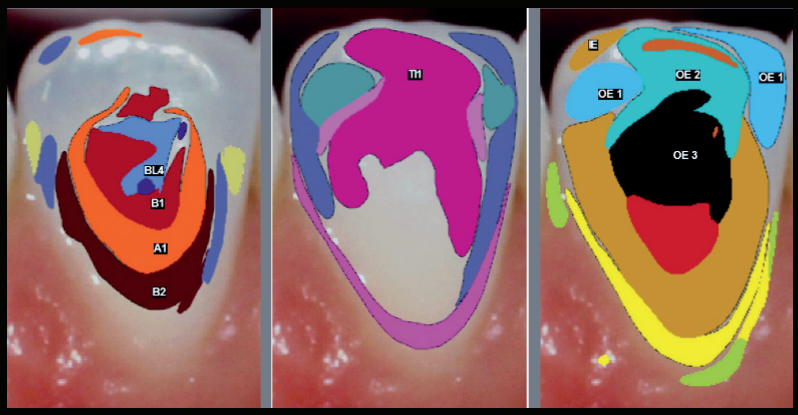

Figure 5: Shade-mapping of tooth shades and translucency intensity.

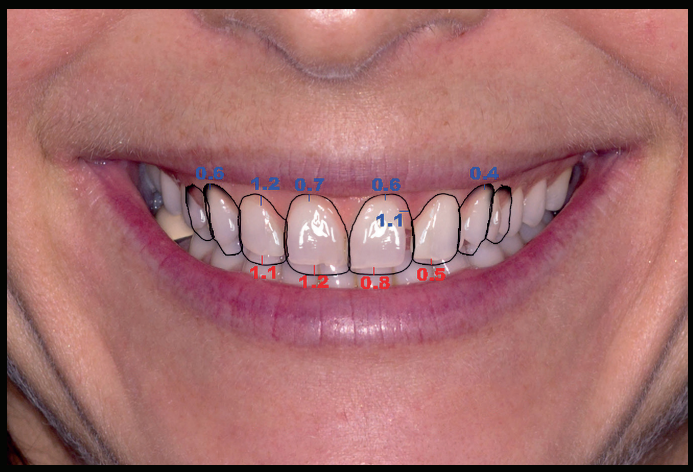

Figure 6: Digital technology was utilized to design the patient's smile and incorporate her preferences for tooth contours, texture, anatomy, and lobing, as well as the overall silhouette of her preferred final smile.

Figure 7: View of the motivational digital mock-up created to demonstrate to the patient the potential of her smile makeover.

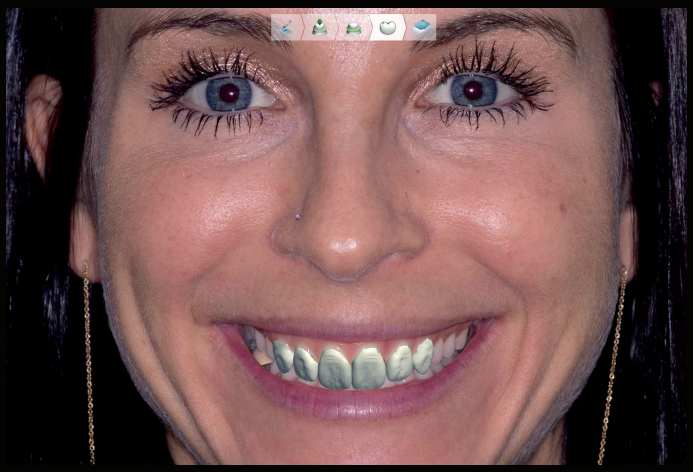

Figure 8: View of the diagnostic wax-up design.

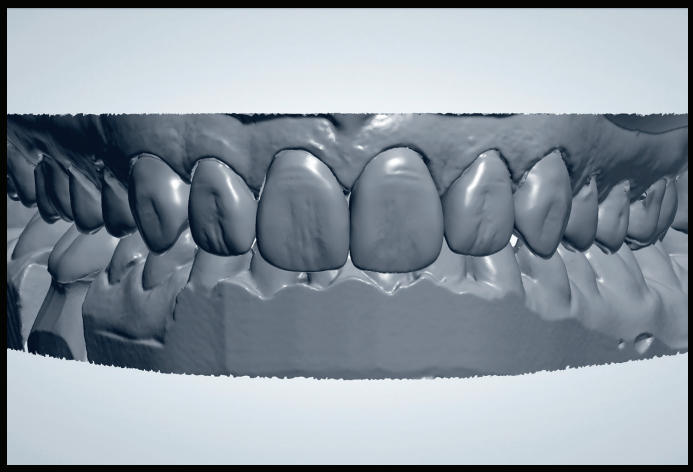

Figure 9: A diagnostic wax-up was created in the laboratory and used for fabricating putty stents.

Figure 10: Left lateral view of the provisional restorations created based on the diagnostic wax-up.

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Treatment

Provisionalization

The patient was anesthetized with 3.5 cartridges of 2% lidocaine with 1:100,000 epinephrine. A soft tissue laser (Waterlase MD, Biolase; Irvine, CA) was used to contour the gingival zeniths of teeth #6, #9, and #11. These sites were probed to ensure the biologic width would not be violated.

Preparation: The patient wished to have her teeth prepared in the most conservative manner possible. However, she still wanted the definitive restorations to achieve the proper axial inclination, proximal contact lengths, gradation in cervical and incisal embrasures, golden proportion, and natural opalescence. Therefore, the putty reduction guide based on the diagnostic wax-up and a preparation cast map for the patient's smile transformation were used to achieve the goals the patient and technician established. These addressed minimal tooth reduction and required lithium disicilate material thickness to achieve the desired effect.[5-7] The reduction guide communicated to the clinician the minimum thickness necessary per tooth, per position, while the preparation map enabled the clinician to verify the minimally invasive nature of the preparations.[8]

The old and failing composite resin restorations on teeth #7 through #10 were removed. In those areas only, removal of material and/or tooth structure (i.e., sound dentin and enamel) was more significant. Depth-cutting burs (Precision Markers 828-037 and 828-026, Strauss & Co.; Palm Coast, FL) were used, after which the margins on each tooth were placed slightly below the free gingival margins using a round-end taper (NeoDiamond 1116.10C, Microcopy Dental; Kennesaw, GA) to hide margin visibility. Because the cuspids required greater facial reduction, a round-end taper bur (790.8C, Premier Dental; Plymouth Meeting, PA) was also used. To finalize the preparations, any internal and external sharp points and line angles were carefully removed using hand instruments, rather than burs, to retain as much original tooth structure as possible.

To establish proper anatomy and emergence contours, the proximal areas were prepared to close uneven diastemas and correct axial inclination. Considerable care was taken to leave as much as possible of the lingual surfaces untouched, since the area near the cingulum was virgin tooth structure. In fact, the lingual cingula of all anterior maxillary teeth were left unchanged.

Final impressions and cementation: A bite registration (MegaBite, Go! Dental; Unley Park SA, Australia) was taken and photographed, after which final impressions were taken using a vinyl polysiloxane material (Imprint 3, 3M ESPE; St. Paul, MN). These records were forwarded to the laboratory.

Prior to creating the provisional restorations, the preparations were disinfected with 2.0% chlorhexidine gluconate (Consepsis Scrub, Ultradent Products; South Jordan, UT), after which all preparation areas were cleaned. The Sil-Tech putty stent was loaded with provisional material (Integrity, Bleach shade, Dentsply Sirona; York, PA), seated onto the preparations, and removed once the provisional material had set. After extraoral trimming and polishing, the provisional restorations were cemented using a noneugenol zinc-oxide temporary cement (Zone, Pentron; Orange, CA).

The patient was pleased with the esthetic improvements to the position, shape, axial inclination, and embrasures of her teeth already visible in the temporary units **(Fig 10)**. She reported that her bite and occlusion with the temporary units in place felt great, and no occlusal adjustments were needed. The patient was given careful and detailed home care instructions, which included using floss thread and an oral irrigator (Hydro Floss; Bessemer, AL) interproximally.

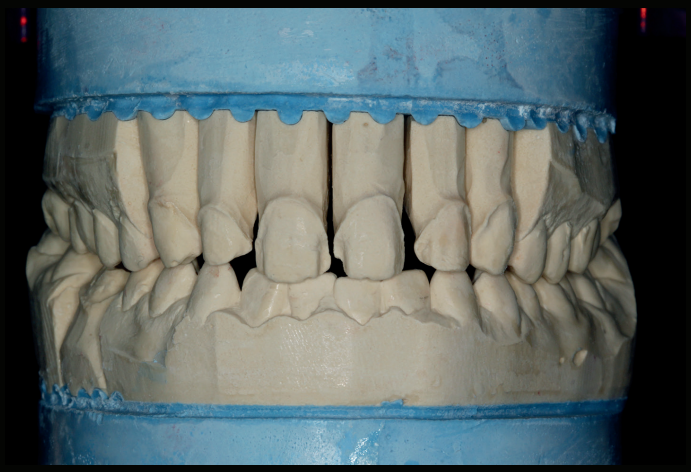

Figure 11: View of the preparation design on the master cast.

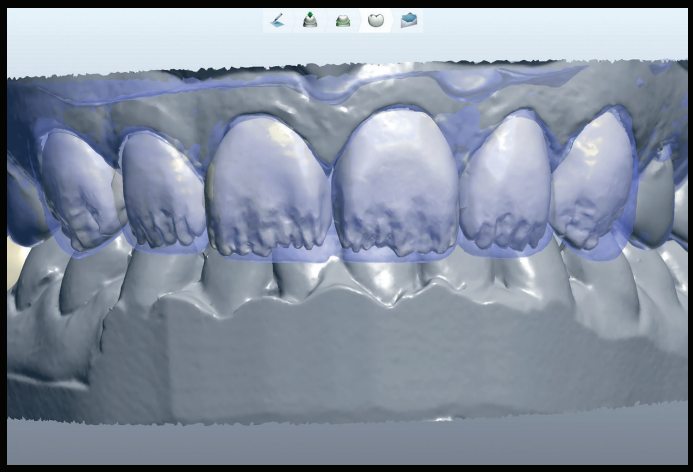

Figure 12: The diagnostic wax-up showing the dentin cutback.

Laboratory Fabrication

Models: After the laboratory received all of the case records, the information was reviewed and verified. Extra-hard stone split cast pinned die models of the upper and lower arches were fabricated (Tan Die Stone, ETI Empire Direct; Anaheim, CA) **(Fig 11)** and cross-mounted, along with the solid and approved provisional models, on the Stratos adjustable articulator.

The temporary, split cast models and dies were scanned (D800 scanner, 3Shape; Copenhagen, Denmark) to create digital models. The margins were carefully marked in the design software (3Shape), after which the six anterior veneers were designed using a Macstudio dentin cutback library **(Fig 12)**, and the approved temporaries as a "ghost image" guide. After confirming that the teeth on the temporary model had been followed in height and width, the design was milled from a beige wax/resin puck in a five-axis milling unit (Wieland Zenotec, Ivoclar Vivadent).

Pressing: The individual wax patterns were then sprued and invested, and the ring bench sat for 20 minutes. The ring was burnt out in a furnace at 1562° F for 45 minutes, after which the ring was placed in a pressing furnace (Programat EP 5000, Ivoclar Vivadent). A cold, isolated IPS Alox-Plunger and a cold medium-translucency lithium disilicate ingot in shade A1 (IPS e.max Press MT A1) were loaded, and the pressing cycle completed.

The hot investment ring was placed on the cooling grid using investment ring tongs and allowed to cool to room temperature. Once cooled, the units were divested utilizing a sandblaster loaded with polishing beads at 2.5 bar. After fine divestment, the white reaction layer formed during the press procedure was removed by submerging the units in IPS e.max Press Invex Liquid, cleaning in an ultrasonic cleaner for at least 10 minutes, and then carefully blasting with type 100-micron aluminum oxide at 1-2 bar (i.e., 15-30 psi).

The sprues were removed, and the restorations fit to the dies. After verifying their fit, the veneers were temporarily luted and secured to the dies using a high-viscosity wash material (Stain Master Kit, Aesthetic-Press; Palm Harbor, FL) to fill the virtual cement gap. This reduced marginal chipping while finishing and provided a visual indicator during cutback. Once contacts were verified, an incisal matrix was made to capture the incisal edge positions.

The restorations were then sandblasted with type 100-micron aluminum oxide at 1-2 bar pressure, after which the surfaces were steam cleaned.

Layering and bake: To achieve the desired incisal translucency, mesial and distal line angles were layered in using a mixture of Impulse OE2/OE3 ceramic powders (IPS e.max Ceram). To enhance the translucent volume and intensity, T Blue was applied on the incisal edge, and the anatomical shape was completed with a mix of Impulse OE1/OE2 **(Fig 13)**.

The veneers were fired in the Programat) to 750° C with a one-minute hold. After removing the units from the oven and allowing them to cool, the proximal contacts were adjusted and the shape checked by comparing them to the study model and incisal matrix **(Fig 14)**. An adjustment bake was performed by adding a mix of Impulse OE1/OE2 at the line angles and TI1 to complete the shape **(Fig 15)**. The units were then fired at 745° C with a 55-second hold.

Figure 13: The combination of a precision CAD/CAM-manufactured wax-up with an artistic layering technique.

Figure 14: A matrix was used to verify the width:height ratio from the wax-up.

Figure 15: Ceramic powder was applied to complete the shape of the veneer restorations.

Figure 16: The veneers were stained and glazed.

Contours and anatomy: Once the restorations cooled to room temperature, they were again luted to the master dies. Contacts, occlusion, and function were spotted using articulating tape (Madame Butterfly Silk, Almore; Beaverton, OR). All contours were shaped using a variety of dental diamond burs (Aesthetic-Press). Surface anatomy and morphology were added to blend with the surrounding natural teeth and the restorations were removed from the dies, cleaned, and fit to the solid model.

Staining and glazing: To verify that the shade and value of the definitive restorations matched the patient's anticipated outcome, the veneers were placed on ND Stump dies (IPS Natural Die Material, Ivoclar Vivadent), photographs were taken with the MicroShade reference guide in place, and the new digital shade maps were compared to the intial shade map of the natutural teeth. Small amounts of stains and glaze (Ivocolor Shades and Ivocolor Fluo Glaze, Ivoclar Vivadent) were applied where needed and fired at 715° C with a 1-minute hold. A glaze firing at 715° C with a 1-minute hold was then conducted using Fluo Glaze to seal in and protect the stain layer **(Fig 16)**.

Verifying contacts: A slight post-firing shine was imparted to the restorations using a diamond polishing system (OptraFine, Ivoclar Vivadent), after which the internal aspect was lightly sandblasted and steamed. The restorations were then fitted back to the solid model to verify contacts and full embrasures. The internal surfaces were lightly conditioned (Ceramic Etching Gel, Ivoclar Vivadent) for 15 seconds. The gel was then rinsed, and the veneers were steamed and dried. After thoroughly ensuring all desired criteria had been met, the case was carefully packaged and shipped back to the dental office.

Figure 17: Postoperative full-face 1:10 frontal view of the patient's completed smile makeover.

Figure 18: Postoperative 1:2 frontal view.

Figure 19: Postoperative 1:2 right lateral view.

Figure 20: Postoperative retracted 1:1 right lateral view of the patient's maxillary teeth.

Figure 21: Postoperative retracted 1:1 frontal view of the patient's maxillary veneer restorations.

Delivery and Cementation

When the patient presented for the delivery appointment, she was very happy with her new smile and indicated that she had maintained her homecare and hygiene. She was anesthetized with 3.5 cartridges of 2% lidocaine with 1:100,000 epinephrine, the provisional restorations were removed, and the preparations were cleaned with hydrogen peroxide and 2.0% chlorhexidine gluconate (Consepsis).

The lithium disilicate veneers (IPS e.max Press) were tried in using a neutral shade try-in paste (Variolink Esthetic, Ivoclar Vivadent). The patient enthusiastically confirmed her satisfaction with the overall esthetic outcome.

The veneers were removed and the preparations cleaned, dried, and isolated with rubber dam. The veneers were then cleaned (Ivoclean) to prevent contamination and discoloration.

The preparations were etched according to a total-etch technique for 15 seconds, then rinsed and dried for 15 seconds. A single-component, light-cured universal adhesive (Adhese Universal, Ivoclar Vivadent) was applied for 20 seconds, air-thinned to avoid pooling, and light-cured for 10 seconds. An esthetic light-cure cement (Variolink Esthetic) was placed into the veneers, after which they were seated and secured onto the preparations with a two-second tack cure. Excess cement was removed from the margins and interproximally, and a final light-cure was performed. Any remaining excess cement was removed using a #12 Bard-Barker blade (Aspen Surgical; Caledonia, MI), the occlusion verified, and the interproximal areas flossed. The veneers were then polished (CeraGlaze, Kerr Dental; Orange, CA) at areas of slight occlusal adjustment.

The patient reported that her bite felt excellent, and that she was extremely pleased with her new smile and her teeth, which were finally even, with no more chips or odd positioning **(Figs 17-21)**. Appliance therapy was discussed, and the patient requested a bruxism guard. The delivery appointment concluded with a discussion reinforcing the importance of proper home care, including oral hygiene, routine flossing, and brushing.

Summary

Careful treatment planning and excellent communication with the laboratory technician are critical to realizing successful case outcomes. The communication among the doctor, patient, and laboratory technician can be enhanced when tools such as smile catalogs, digital smile designs, diagnostic wax-ups, and reduction guides are used throughout the process. In this case, the utilization of these tools enabled the patient to share her expectations and then visualize the sequencing of her treatment every step of the way. She was very pleased with the cosmetic result and, most importantly, she was extremely impressed with how conservative the treatment was and valued the overall treatment process.

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