ACHIEVING EXCELLENCE *with a* MINIMALLY INVASIVE INTERDISCIPLINARY APPROACH

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Abstract

The restoration of one or two teeth in the anterior dentition is one of the most challenging procedures a dentist can perform. This article discusses the use of tooth alignment in conjunction with thorough laboratory communication to produce a conservative and esthetic outcome with two porcelain veneers. Using digitally planned orthodontic treatment modalities to create the ideal amount of space around teeth allows for symmetrical restorative options that involve less removal of tooth structure.

Key Words: ortho-restorative, laboratory communication, veneers, minimally invasive dentistry

Introduction

Some of the most demanding cases in cosmetic dentistry require a skilled practitioner to match a single anterior restoration that harmonizes with the patient's existing smile. Biological "imperfections" and characterizations are often observed in natural dentition and must be replicated. Fortunately, technological advances in materials and digital photography allow us to communicate the unique characterizations that are necessary for designing and fabricating a successful single-unit anterior restoration. Incorporating subtle, yet essential, characterizations into an esthetically challenging case is the hallmark of a superior laboratory technician. This case demonstrates such talents.

Case Presentation

Chief Complaint

The patient presented to the practice dissatisfied with the shape and appearance of her teeth. She had no history of orthodontia or esthetic dental treatment and wanted to explore options for improving her smile. Additional complaints included thinning incisal edges of her maxillary incisors, mild rotations with uneven incisal edges in her mandibular incisors, and diastemas present on the upper and lower arches **(Fig 1)**. Finances were of concern to the patient, and she expressed interest in a conservative approach with respect to any potential removal of her natural tooth structure.

Dental and Medical History

The patient's systemic health was good. Periodontally, she was stable, with minimal inflammation and good home care. Biomechanically, she had a history of routine restorative care including resins, and a recently removed mandibular molar due to an infection. The patient had a normal range of motion, and no crepitus was noted on examination of her temporomandibular joints. There was no muscle tenderness and no pain upon opening or during lateral movement. The patient reported no signs or symptoms of temporomandibular disorders. Upon closer examination, it was noted that she had limited overjet, as well as evidence of functional wear. This was likely a contributing factor to the thin appearance of her maxillary and mandibular incisors.

Figure 1: Pretreatment full-face smile view (1:10).

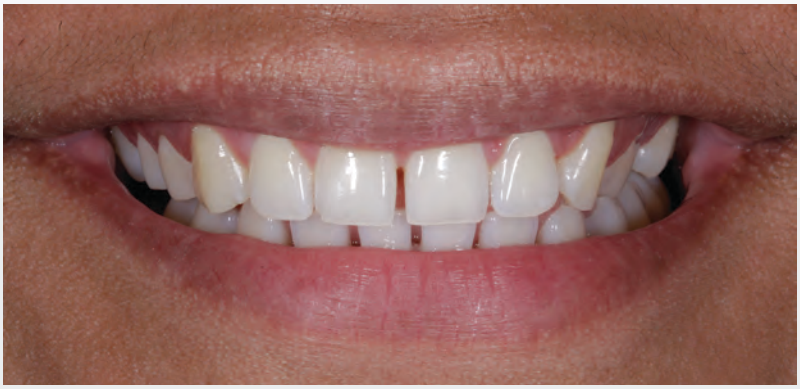

Figure 2: Preorthodontic full-smile frontal view (1:2) revealing the collapsed buccal corridor and diastemas.

Diagnosis and Treatment Plan

It was very important to the patient that her treatment be conservative. She was emphatic that she did not want to undergo any more restorative dentistry than necessary and preferred a more "natural" appearance. To achieve the patient's esthetic goals and remain conservative, it was decided that the modality of choice would be indirect, minimal preparation veneers for teeth #8 and #9. The treatment would be completed in two phases as follows:

Phase I: Orthodontic therapy to correct tooth position, eliminate the diastemas within the patient's mandibular arch, redistribute the maxillary diastemas, increase the overjet, correct the crossbite (which would result in improved arch form with increased buccal corridor smile display), and level both arches utilizing clear aligner therapy **(Fig 2)**.

Phase II: Restorative treatment would allow for fabrication of indirect veneers on #8 and #9 that would not only be beautiful but would also withstand functional movements, and correct the patient's concerns. A Bolton analysis determined that #8 and #9 did not exhibit proper dimensions for arch relationships.[1] The other significant challenge in this case was making the veneers look natural, rather than "perfect."

Treatment

Clear aligner therapy: This first treatment step required data collection consisting of photos, radiographs, and digital scans. The American Academy of Cosmetic Dentistry's (AACD) required series of 12 Accreditation photographs was taken with a 5D EOS camera and 100-mm macro lens with a ring flash (Canon; Melville, NY).[2] A cone beam computed tomography scan was obtained and converted to a panoramic image for submission to the orthodontic laboratory (Align Technology; Tempe, AZ). Periapical radiographs of #8 and #9 were made with a digital sensor (Dexis; Quakertown, PA). Both radiographs were fully analyzed and did not reveal any pathology or contraindications for treatment. A scanner (iTero, Align) was utilized to capture digital impressions and a bite record. A digital visualization tool (ClinCheck, Align) was reviewed and modifications were made prior to manufacturing the clear aligners. After the orthodontic lab sent a full set of clear aligners to the dental office, the patient completed the prescribed treatment to achieve the desired functional and preoperative esthetic results **(Figs 3a & 3b)**.

Diagnostic wax-up and whitening: Upon completion of orthodontic therapy, the restorative phase of treatment was

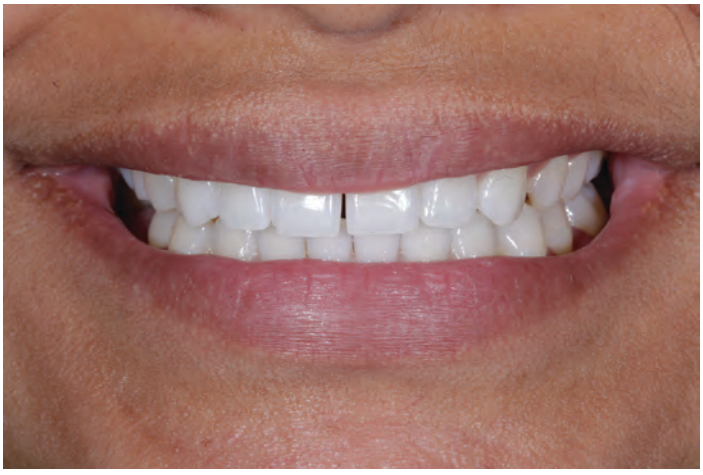

Figure 3a: Preoperative full-smile frontal view (1:2) showing the corrected crossbite and the planned residual diastema.

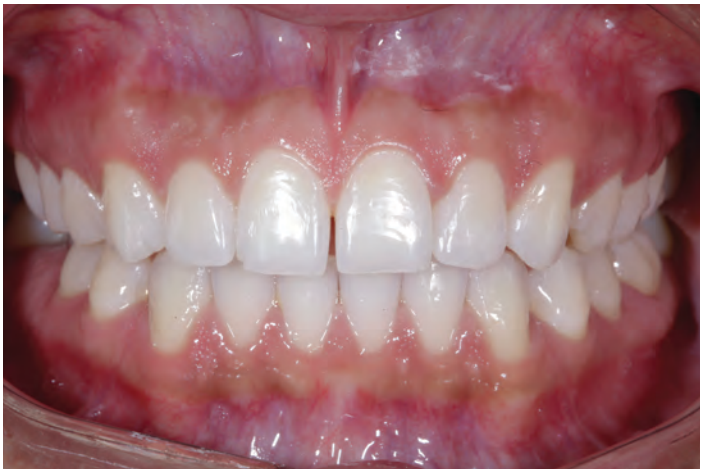

Figure 3b: Preoperative retracted frontal view (1:2) displaying the corrected crossbite and closed mandibular diastemas.

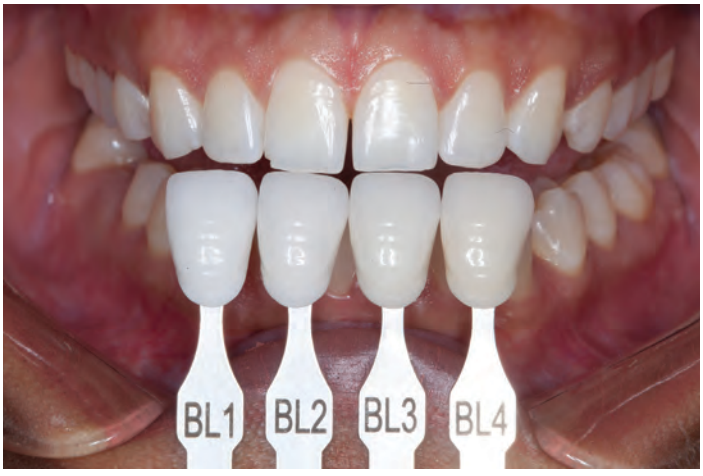

Figure 4: Preoperative retracted frontal view (1:2) demonstrating how to position multiple shade tabs with neutral lighting.

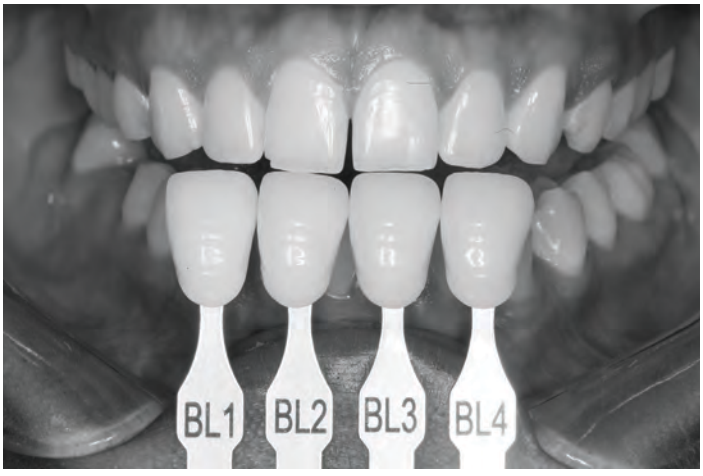

Figure 5: Preoperative retracted frontal view (1:2) in monochromatic picture mode for value selection.

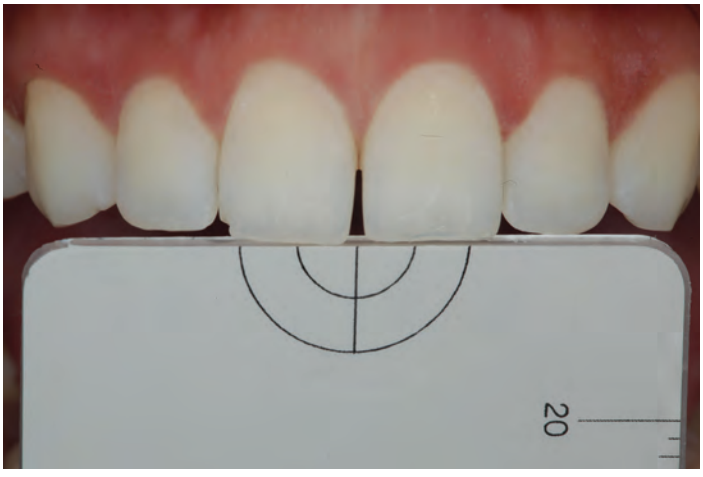

Figure 6: Preoperative retracted frontal view (1:1) utilizing a gray card and polarized lens.

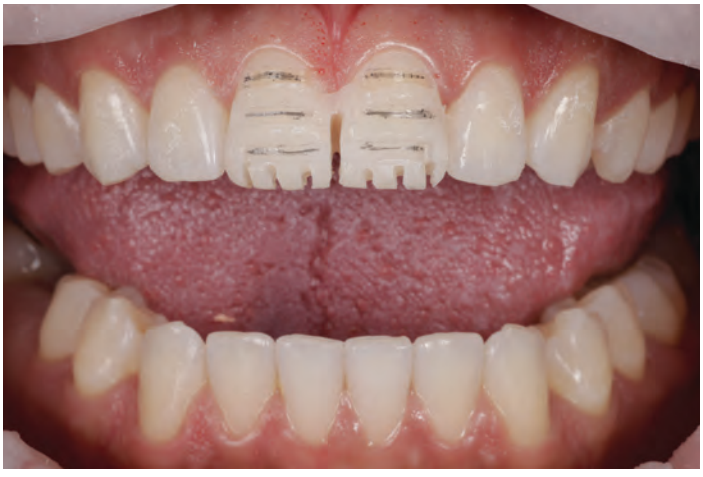

Figure 7: Retracted frontal view (1:2) exhibiting the facial, incisal, and interproximal depth cuts through the provisional material.

initiated. Custom whitening trays were fabricated, and the patient followed a 30-minute regimen daily for 1 week utilizing 35% carbamide peroxide gel (Opalescence, Ultradent Products; South Jordan, UT). An additive diagnostic wax-up was prepared that would enable the veneer preparation design to remain in enamel to achieve the patient's goals of tooth preservation and predictable treatment.[3]

A putty matrix (Ivoclar Virtual XD, Ivoclar Vivadent; Amherst, NY) lined with vinyl polysiloxane (VPS) (Affinity, Clinician's Choice; London, ON) was fabricated on the wax-up model and used to construct a mock-up in the patient's mouth with bis-acrylic (Luxatemp Automix, DMG America; Ridgefield Park, NJ). The patient was happy with and accepted the proposed esthetic outcome.

Photography and shade selection: To avoid inaccurate selection due to enamel dehydration during the tooth preparation appointment, the shade was selected at the beginning of the procedure appointment.[4] A two-week stabilization period was observed after whitening prior to preparing the teeth and taking the patient's final shade-matching photos due to the delayed effects of color stability.[5] Shades were taken using three different techniques for effective communication with the laboratory ceramist. The first technique involved capturing the teeth as they appear to the naked eye by means of multiple shade tabs (VITA 3D, VITA North America; Yorba Linda, CA) with neutral lighting that allowed the ceramist to create a custom shade during the fabrication process **(Fig 4)**. The second technique helped to determine the restoration's value by capturing the shade tabs in monochromatic picture mode **(Fig 5)**. The third technique utilized a white balance gray card (eLAB Prime; Bresigau, Germany). This method focused on the teeth adjacent to those being restored to calculate the shade utilizing artificial intelligence and advanced image processing **(Fig 6)**.

Preparation: Local anesthetic (Septocaine 4%, Septodont USA; Lancaster, PA) was infiltrated to anesthetize the teeth and tissue for patient comfort. The teeth were prepared per the technique pioneered by Gürel for minimum preparation design and to create a uniform space for the restorative material.[6] The putty matrix was filled with bis-acrylic provisional material (Luxatemp Automix), seated over the teeth, and allowed to cure. Upon removal of the stent, the cured set of provisionals could be observed overlaying the unprepared teeth. Preparations were accomplished through the overlaid provisional material using reduction burs (Brasseler USA; Savannah, GA) to ensure the minimal amount of facial, incisal, and interproximal tooth structure was removed to achieve the optimal preparation outcome in the following sequence **(Fig 7)**:

1. A depth-cutting diamond bur (868D.31.030) was used to create 0.5-, 0.7-, and 0.9-mm horizontal depth grooves on the labial surface at each plane, respectively.
2. A pear-shaped carbide bur (BRIOH7.31.008) was used to create 1.6-mm incisal depth cuts and to cut through the mesial interproximal contact of #8 and #9.
3. A tapered round-end coarse diamond bur (KS1L 35005L.31.052) was used to create uniform reduction of the facial surfaces.
4. A tapered round-end chamfer fine diamond bur (8856.31.016) was used to smooth all surfaces and round sharp edges.

The preparation design for closure of the diastema interproximal to #8 and #9 required preparation beyond the mesial proximal surface and extension of the preparation subgingival (without invading the biologic width) in that region for the ceramist to have proper space for emergence form and ideal contacts **(Fig 8)**. A preparation shade (ND1, Ivoclar Vivadent) was selected and captured with neutral lighting to send to the lab along with the preoperative shade photos.

"TECHNOLOGICAL ADVANCES IN MATERIALS AND DIGITAL PHOTOGRAPHY ALLOW US *to communicate* THE UNIQUE CHARACTERIZATIONS THAT ARE NECESSARY *for designing* AND FABRICATING A SUCCESSFUL SINGLE-UNIT ANTERIOR RESTORATION."

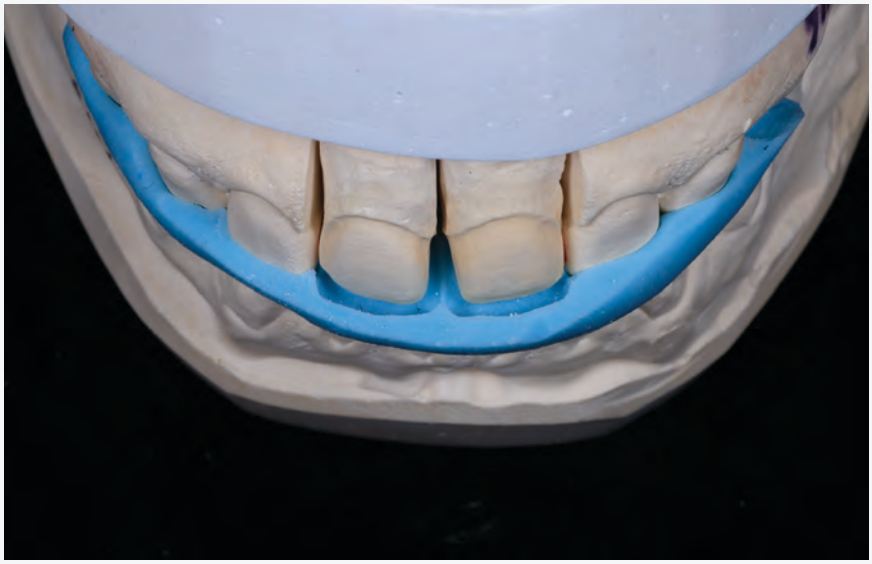

Figure 8: Master cast showing the preparation design and reduction.

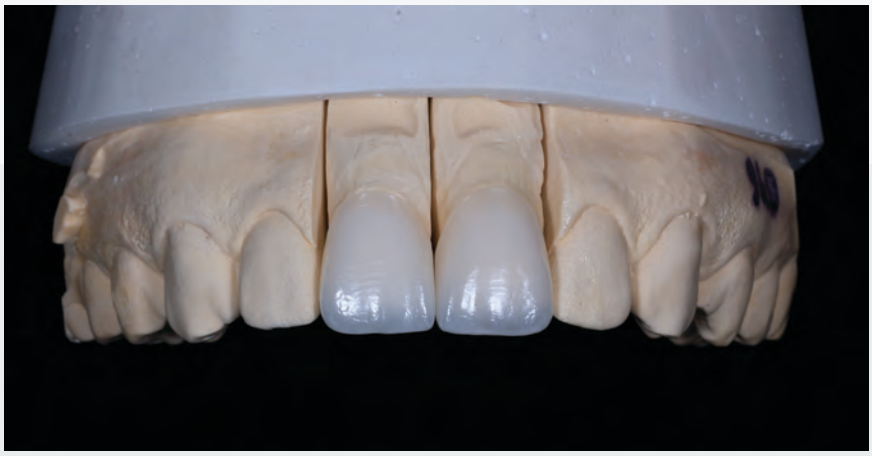

Figure 9: Feldspathic porcelain veneers with texture and light properties that mimic nature.

Impressions: Retraction cord (#00 Ultrapak, Ultradent) was placed into the gingival sulcus of the prepared teeth. The teeth were thoroughly rinsed and dried prior to the impression. A full-arch stock lower mandibular tray was used for the final preparations' impression. VPS material (Affinity Fast-set, Light Body) was dispensed onto the preparations and a heavier viscosity VPS material was dispensed into the tray (Affinity Fast-set, Heavy Body) around the preparations. The filled tray was seated over the upper arch and left in place for three minutes per the manufacturer's instructions. The retraction cord was removed from the sulcus when the impression was completed. A lower impression was made with the heavy-body VPS and a bite record was recorded with bite registration material (Quick Bite, Clinician's Choice).

Provisionals: The provisional restorations were fabricated by filling the laboratory-fabricated provisional matrix with bis-acrylic provisional material (Luxatemp Automix B1). After 90 seconds, the matrix and the cured provisional were removed from the patient's mouth. Then the provisional restoration was shaped and contoured extraorally with flexible discs (FlexiDisc, Cosmedent; Chicago, IL). The provisional was secured in place using a spot-etch technique (a small dot of 35% phosphoric acid was applied for 15 seconds, then rinsed), bonding agent (All-Bond Universal, Bisco; Schaumburg, IL) and flowable composite (Tetric EvoFlow Translucent, Ivoclar Vivadent) dots were applied on the facial of #8 and #9, and the provisional was seated over it. A curing light (BluPhase Powercure, Ivoclar Vivadent) was used for 30 seconds with facial and incisal pressure to keep the provisional in place. The patient returned 24 hours later and approved the provisionals' fit and esthetics, after which they were scanned (iTero) and records sent to the lab for duplication of the design for the final restorations. The patient was prescribed doxycycline hyclate 20 mg BID (Periostat, Galderma Laboratories;

Fort Worth, TX) to maintain gingival health. She was instructed to take the Periostat three weeks prior to preparation and to discontinue it one week after cementation.

Final restorations: The lab was provided a complete set of records and instructions including a prescription for the fabrication of the restorations, a maxillary master impression, a mandibular impression, a bite registration, the patient-approved diagnostic wax-up, the AACD's 12-photograph Accreditation series, shade photos, and photos of the preparation shade. It was important to communicate the proper interproximal contact point position to the laboratory technician to avoid black triangles. The lab was instructed to position the apical aspect of the contact no more than 4 mm from the crest of bone.[7]

Feldspathic porcelain (IPS Style, Ivoclar Vivadent) on platinum foil was layered to fabricate the veneers for excellent esthetic outcomes to mimic natural dentition. The master ceramist used underlying high-luminosity dentin, building it into the shape of the tooth, again employing dentin with bleach to make the restoration appear bright; B1 dentin was used to make it appear less bright. Internal lateral segmental layering of various opal enamel porcelains was added. The final skin layer was OE1 and OE3; the mid skin layer was OE3 and neutral. The ceramist developed the shape and contour in the skin layer **(Fig 9)**. Due to the patient's correction of her functional problems by alignment of the bite, the strength of the material that was chosen was not a concern.

Cementation: Local anesthetic (Septocaine 4%) was infiltrated to anesthetize the teeth and tissue for patient comfort on the day of insertion. A pear-shaped carbide bur (BRIOH7.31.008) was used to create a slot on the facial aspect and separate the provisional with a flat-ended hand instrument. The teeth were air-abraded (PrepStart, Zest Dental Solutions; Danville, CA) to remove residual bonding material prior to try-in to reduce the risk of porcelain fracture or incomplete seating. The final veneers were inserted temporarily with translucent try-in gel (NX3 Try-In Gel, Kerr Dental; Brea, CA), checked for fit and esthetics, and approved by the patient and dentist.

A thick rubber dam was placed for isolation from tooth #5 to tooth #12 (Nic Tone; Bucharest, Romania). Two W2 clamps were used to anchor the dam on the premolars and two B4 clamps were used to retract it on the prepared teeth **(Fig 10)**. The veneers had previously been etched with 9% hydrofluoric acid (Ivoclar Vivadent) by the ceramist. The veneers' bonding surfaces were cleaned (Ivoclean, Ivoclar Vivadent) for 20 seconds, then thoroughly rinsed and dried to remove any contamination that occurred during the try-in. The veneers were then silanated (Monobond Plus, Ivoclar Vivadent) for three minutes.

The teeth were cleaned with 27-µm aluminum oxide at 40 psi with air abrasion (PrepStart), after which they were etched with 35% phosphoric acid for 30 seconds and rinsed. The teeth were dried, and the bonding agent (Adhese, Ivoclar Vivadent) was applied and agitated on the surface for 20 seconds and then light-cured for 20 seconds (BluPhase Powercure). A thin layer of translucent resin cement (Variolink Esthetic, Ivoclar Vivadent) was applied to the inside surface of the restorations. Each restoration was placed individually with light finger pressure and excess cement was cleaned with a gingival stimulator. The restorations were tacked into place under finger pressure with a three-second light cure. Flossing was performed interproximally and a Nevi scaler (Hu-Friedy; Chicago, IL) was used to remove excess cement around the margins. The restorations were then thoroughly light-cured for 30 seconds **(Fig 11)**.

After the rubber dam and clamps were removed, the patient's occlusion and functional movements were evaluated using 21-µm articulating paper (AccuFilm II, Parkell; Edgewood, NY), and 200-µm occlusal paper (Bausch; Nashua, NH) was used with the patient seated upright and making chewing movements to confirm no pathway interferences existed. A #12 scalpel blade (Hu-Friedy) was used to remove any residual cement. A post-cementation smile photo was taken and shown to the patient to demonstrate the effects of dehydration and inform her that she would need to return in three weeks for final records **(Fig 12)**.[4] Lastly, a periapical radiograph was taken to confirm well-sealed margins.

Follow-up: As directed, the patient returned three weeks later for the final series of AACD Accreditation photographs. The photos showed a successful esthetic outcome and healthy gingiva.

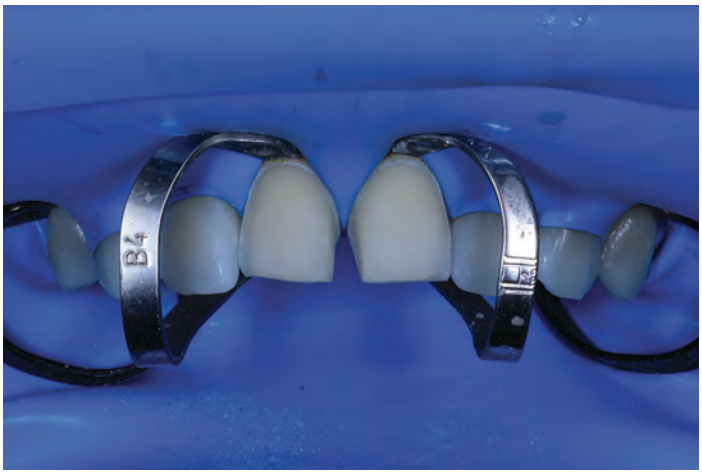

Figure 10: Rubber dam clamp placement and air-abraded and etched preparations.

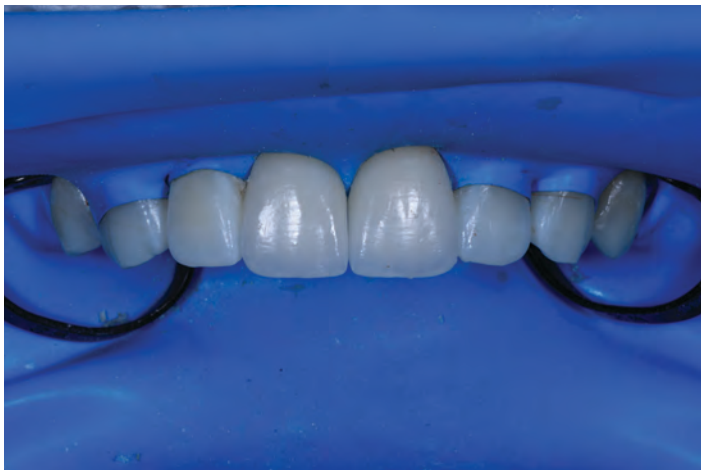

Figure 11: The veneers were cemented under rubber dam isolation.

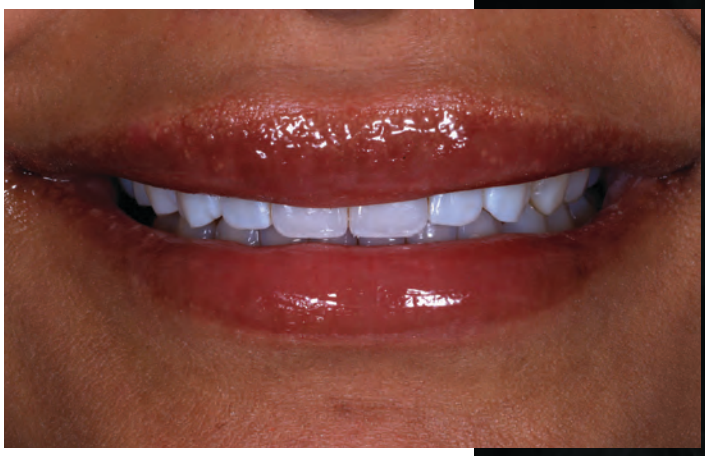

Figure 12: Postoperative full-smile frontal view (1:2) revealing the effect of immediate isolation.

Figure 13: Postoperative full-face smile view (1:10) of a very happy patient.

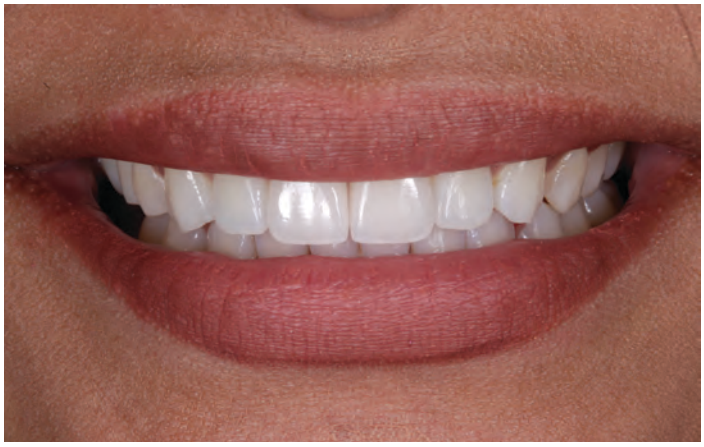

Figure 14a: Postoperative full-smile frontal view (1:2) exhibiting how the final restorations enhance the patient's natural smile.

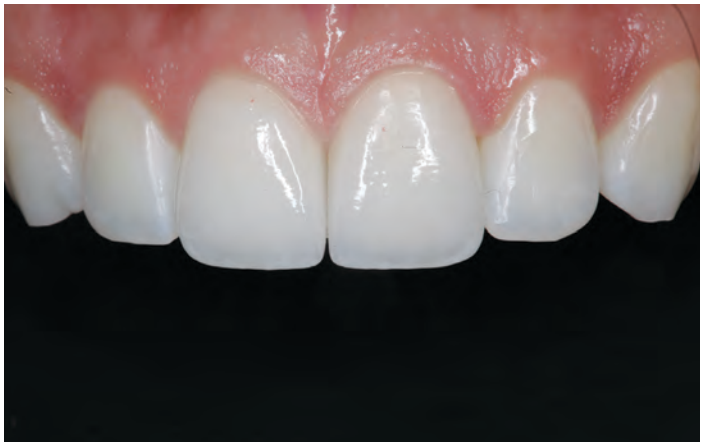

Figure 14b: Postoperative view (1:1) showing the value, hue, chroma, shape, and texture mimicking the natural dentition to achieve the patient's desired outcome.

> REDISTRIBUTING THE SPACE AND LEAVING THE MESIAL DIASTEMAS ALLOWED FOR *successful esthetics* AND FUNCTION WHILE PRESERVING NATURAL TOOTH STRUCTURE.

Summary

The patient was delighted with the results **(Fig 13)**. If the size discrepancy between teeth #8 and #9 had not been identified prior to treatment, the case would have required more extensive tooth removal to provide an acceptable prosthetic result and might have resulted in a poor smile design outcome. Redistributing the space and leaving the mesial diastemas allowed for successful esthetics and function while preserving natural tooth structure. This case demonstrates how clear aligner therapy, in conjunction with excellent planning and information, enables a master ceramist to create veneers that mimic natural teeth and enhance the patient's smile **(Figs 14a & 14b)**.

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