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Pursuing *Conservative* Esthetics

An Interdisciplinary Treatment Approach for Minimally Prepared Porcelain Laminate Veneers

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Abstract

Ultimate restorative success always begins with an accurate diagnosis and a carefully designed treatment plan, which often mandates an interdisciplinary approach. The goal of minimally prepared veneers is to preserve as much enamel as possible, because bonding to enamel is more predictable than bonding to dentin. Keeping the majority of the preparation in enamel has been shown to improve long-term success. This article emphasizes an interdisciplinary approach, minimally invasive treatment, and guided tooth preparations, based upon a digital smile design, a diagnostic wax-up, and a mock-up.

Key Words: interdisciplinary treatment, minimal preparation, porcelain laminate veneers, digital smile design, diagnostic wax-up

Introduction

Restorative success always begins with an accurate diagnosis and a carefully designed treatment plan, which often mandates an interdisciplinary approach. To achieve long-term functional and esthetic success with porcelain laminate veneers (PLV), a minimally invasive approach for enamel preservation is critical. The overall survival rate for PLVs after 10 years in service can be as high as 93.5% when they are bonded mainly to enamel.^{1,2} Therefore, orthodontic movement of the teeth into a position that can preserve enamel and accommodate minimal intraenamel tooth preparation is one of the most important considerations with this treatment modality. When planned and conducted carefully, minimal preparation design can be used to achieve predictable bonding interaction between enamel and ceramic.³

A diagnostic wax-up is critical for planning esthetic restorations because it serves as a blueprint to evaluate the potential esthetic and functional outcome of the case. In addition, it helps to determine whether minimal tooth preparation can be achieved without creating overcontoured restorations, or if orthodontic treatment is needed to reposition the teeth. Furthermore, reduction guides can be generated from the wax-up to allow the control of conservative tooth preparation. The goal of the case discussed here was to improve esthetics while pursuing a conservative treatment utilizing an interdisciplinary approach.

Case Presentation

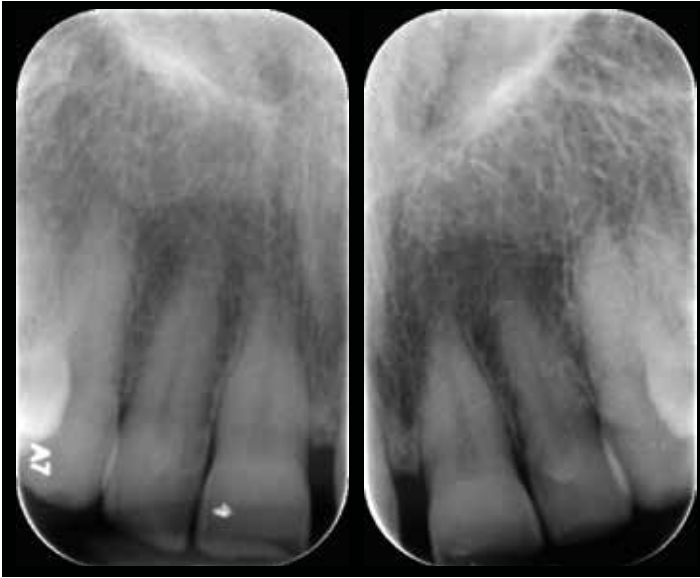
A 50-year-old female wished to have a “perfect” smile, achieved through conservative treatment. She had an excessive gingival display, diastema between the central incisors, and deficient tooth volume in the buccal corridors (Figs 1a-1c). Radiographs of her maxillary anterior teeth showed short root lengths, which represented a contraindication for a significant crown-lengthening procedure (Figs 2a & 2b). She displayed excessive wear in the anterior teeth and reported grinding her teeth at night (bruxism). Based upon the compromised esthetic and functional situation, a treatment plan was developed and presented to the patient as follows:

1. Orthodontic treatment to correct tooth position, and space management to minimize surgical needs and tooth reduction.
2. Gingivoplasty and frenectomy.
3. Minimal preparation porcelain laminate veneers and an occlusal guard after treatment.

The patient had a normal range of motion and no joint sounds at external palpation. There was no muscle tenderness and no pain upon opening or during lateral movement. There were no signs or symptoms of temporomandibular disorders.



Figures 1a-1c: Preoperative extraoral and intraoral images of the patient showing generalized worn dentition and a diastema between the central incisors.



Figures 2a & 2b: Radiographs of maxillary anterior teeth showing very short root lengths.

The first goal of the orthodontic treatment was to intrude the patient's maxillary and mandibular central/lateral incisors back to their original positions...



Figure 3: Orthodontic treatment to intrude the central/lateral incisors, level the occlusal plane, and manage space.

Minimal Preparation Concept

The goal of minimally prepared veneers is to preserve as much enamel as possible, because bonding to enamel is more predictable than bonding to dentin.⁴ Keeping the majority of the preparation in enamel has been shown to improve long-term success: Friedman observed that the best long-term retention for porcelain veneer restorations is achieved when at least 50% of the supporting substrate is enamel and all finish lines end within the enamel.⁵ Ideal tooth position and diagnostic wax-ups are key to success with this concept; and, to avoid overpreparation that leads to dentin exposure, the enamel reduction is guided by a diagnostic wax-up design and mock-up.⁶

Orthodontic Treatment

The first goal of the orthodontic treatment was to intrude the patient's maxillary and mandibular central/lateral incisors back to their original positions prior to supraeruption due to alveolar compensation from her worn dentition over time. Also, the clinical roots of the incisors were short, and repositioning the gingival levels with aggressive clinical crown lengthening surgery is contraindicated in this situation. The second goal was to align the tooth axes and manage space for pleasing tooth proportion of the veneer restorations. The third goal was to reduce the excessive vertical overlap and to increase the horizontal overlap. To that effect, it was planned to provide adequate restorative space and shallower anterior guidance by preserving the same 25% vertical overlap taken into orthodontic intrusion and the final restoration plan, as well as providing a 1-mm final horizontal overlap restoration design. Relieving the constricted envelope of function would help to minimize functional problems due to bruxism, as well as potential fracture of the restorations in the future (Fig 3). After completion of orthodontic treatment, the worn incisal edges of the mandibular anterior teeth were restored with composite resin as a conservative treatment in accordance with the patient's wishes (Figs 4 & 5).



Figure 4: Composite buildup on mandibular anterior teeth after completed orthodontic treatment.



Figure 5: Frontal view after completed orthodontic treatment.

Digital Smile Design

The digital smile design (DSD) concept⁷ was used in this case to provide precise calibrated information such as patient images and models to communicate between the team members. It was used at the pre-orthodontic and post-orthodontic treatment phases to evaluate and design the esthetic wax-up (Figs 6-8). Pre-orthodontic treatment esthetic analysis with the DSD concept provided useful information for discussion between the clinician and the patient, and between the restorative dentist and the orthodontist, periodontal surgeon, and dental technician. It served as a guide for future gingival position, space management, and ideal tooth position for minimum preparation and adequate space for restorative material. Post-orthodontic treatment evaluation with the DSD concept gave precise information to the clinician and technician that resulted in a minimal gingivectomy to correct the gingival levels and a new esthetic wax-up design (Fig 9) that was transferred to the patient with an indirect mock-up (Fig 10).

Surgical Phase

A frenectomy was completed after orthodontic treatment to prevent any relapse between the central incisors (the patient had reported that the size of the diastema had increased over the years). In addition, a minor gingivectomy with electrosurgery was performed to follow the diagnostic wax-up and mock-up design to create symmetry and harmonious and pleasing proportions for the future restorations (Figs 11a & 11b).

A frenectomy was completed after orthodontic treatment to prevent any relapse between the central incisors.



Figure 6: Frontal view of the digital smile design schematic compared to existing tooth shape and space.

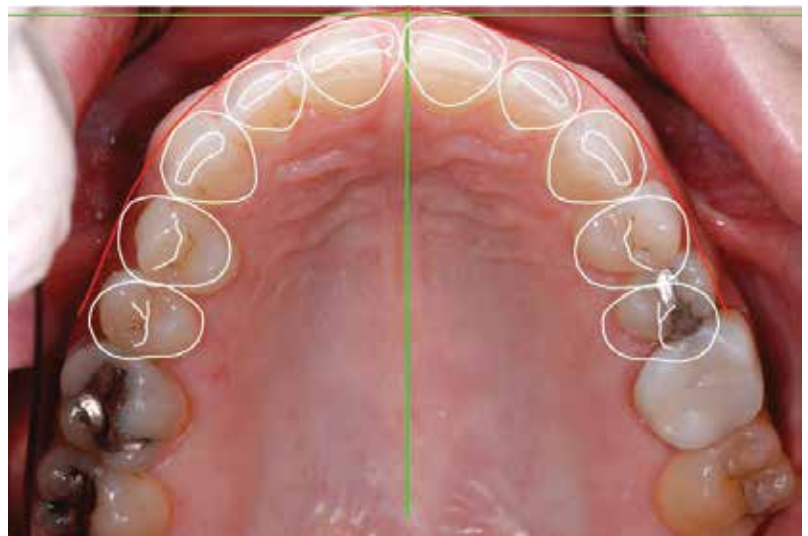


Figure 7: Occlusal view of the digital smile design schematic compared to existing tooth shape and space.



Figure 8: Frontal view of the digital smile design schematic compared to the patient's tooth shape and space after orthodontic treatment.



Figure 9: Diagnostic wax-up following schematic of the digital smile design.



Figure 10: Patient's smile with indirect mock-up with Bis-GMA and matrices duplicated from diagnostic wax-up.



Figures 11a & 11b: Frenectomy and gingivectomy.

Preparation Sequence

Three-quarter coverage design for the canine-to-canine veneers allowed for restoration of the occlusal contacts with the mandibular incisors and canines and optimization of anterior guidance and the envelope of function. Conventional coverage design of the premolars allowed for filling of the buccal corridors and harmonization with the increased volume of the anterior teeth.

Preparations were made via the mock-up, using the technique pioneered by Gürel for minimum preparation design and to create a uniform space for the restorative material.⁸ The indirect mock-up was created with a polyvinyl siloxane (PVS) (Extrude, Kerr; Orange, CA) matrix from the diagnostic wax-up and Bis-GMA (Integrity, Dentsply; York, PA). After the patient approved the mock-up the preparations were accomplished in the following sequence using the Chiche preparation kit (Brasseler USA; Savannah, GA):

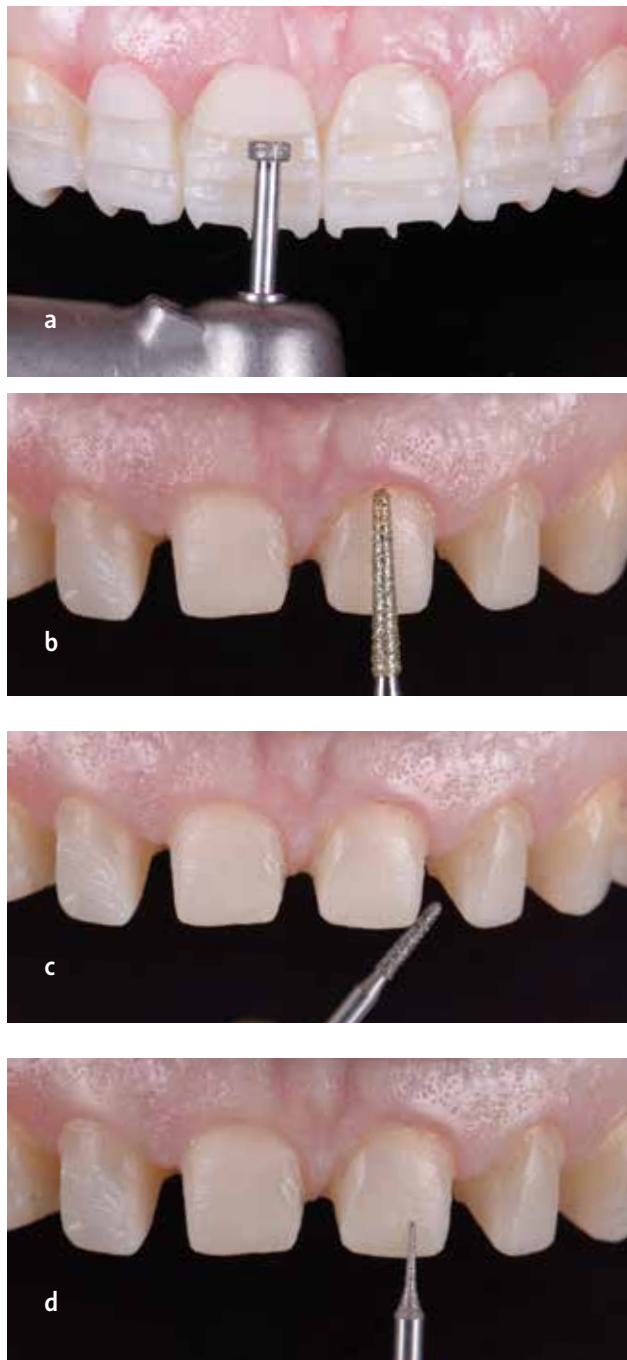
1. A wheel-shaped diamond-coated bur (828-026) was used to create 0.5-mm horizontal depth grooves on the labial surface and 1-mm vertical depth grooves on the incisal edge.
2. A tapered coarse bur (LVS4 014) was used to create a uniform reduction, a short tapered chamfer fine-diamond bur (876K 012) was used to smooth all surfaces, and a mosquito diamond bur (8392 016) was used to round off all incisal line angles (Figs 12a-12d & Fig 13).
3. A PVS impression was made with a 000 cord (Ultrapack, Ultradent Products; South Jordan, UT). Using the smallest cord diameter will minimize the likelihood of gingival recession.
4. The provisional restoration was made with Bis-GMA shade A1 (Protemp, 3M ESPE; St. Paul, MN)) from a PVS matrix (Fig 14).

The impression of this provisional was made with an irreversible hydrocolloid impression material (Jeltrate, Dentsply) to be used as a reference for the mounting working cast, and control the length, width, and contour of the final restorations.

The patient had requested "perfect" alignment and an ideal smile. This was visualized with the trial smile design of her provisional restorations as well as her comments to the laboratory after wearing them. A duplicate model of the provisional restorations was also communicated to the laboratory.

Laboratory Fabrication

The restorations were fabricated using lithium disilicate (IPS e.max Press, Ivoclar Vivadent; Amherst, NY) because of its high flexure strength. The definitive wax design of the final restorations was performed on the master solid cast. The restorations were pressed with the Value 3 lithium disilicate glass ceramic ingot. After adapting the margins and adjusting the fit of the restorations, the veneers were seated on the master solid cast.



Figures 12a-12d: Step-by-step images of tooth preparation for veneer restoration.



Figure 13: Frontal view of tooth preparation as a three-quarter veneer on incisors and conventional preparation on canines and premolars.

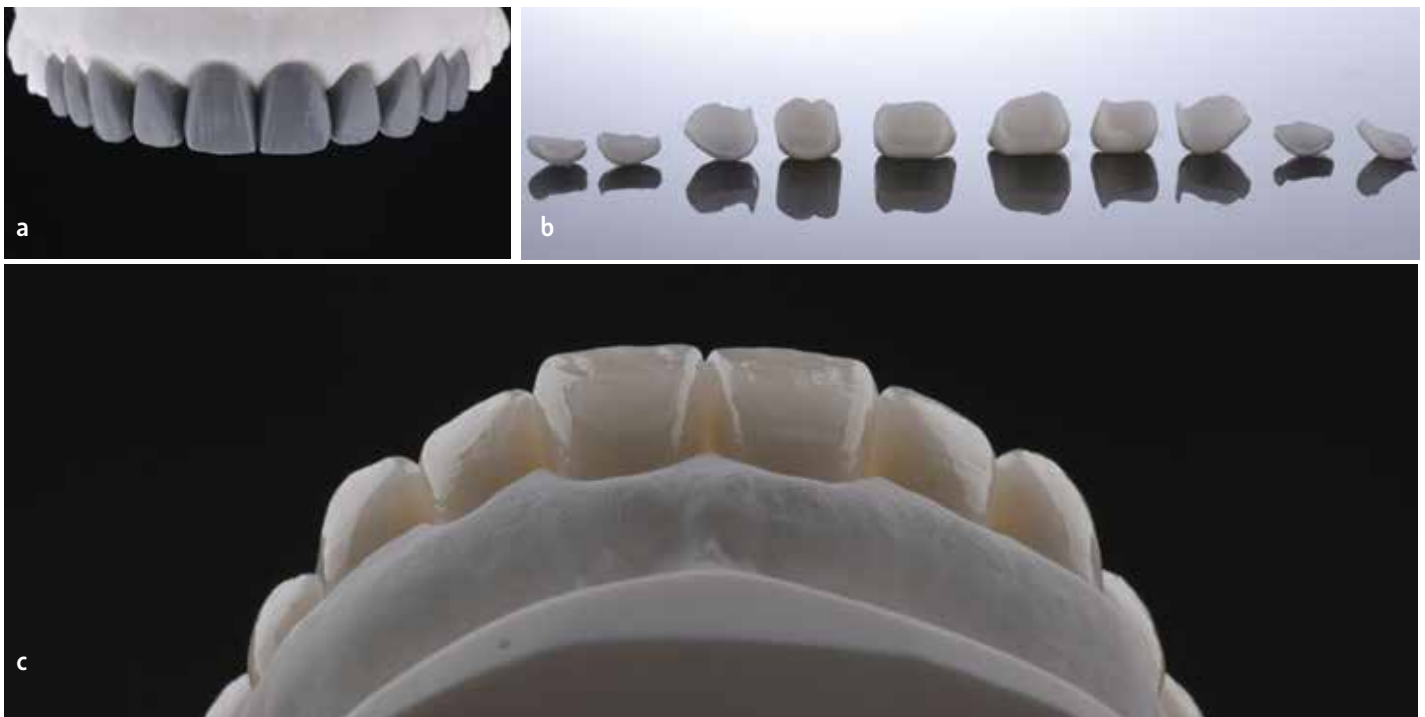


Figure 14: Frontal view of provisional to protect sensitivity and for use as a prototype for the final restoration.

Conventional coverage design of the premolars allowed for filling of the buccal corridors and harmonization with the increased volume of the anterior teeth.

To achieve lifelike characteristics of the ceramic, subtle external stains must be used on the surface prior to glazing. Monolithic lithium disilicate was used because the patient had reported a grinding habit and she did not want to have a lot of translucency at the incisal edge. A very simple staining approach was utilized to achieve this goal: blue stain was applied in the incisal area, white stain was mixed with a cervical shade for the mamelons, and, finally, the cervical color of the basic hue of the target shade was used apically. Pure white should be applied in the incisal area but in specific spots and in different intensities. After the staining effects were completed, a fixation firing was carried out followed by a glaze paste application and hand polishing with silicone wheels (Edenta; Au, St. Gallen, Switzerland) (Figs 15a-15c & Fig 16).

“Monolithic lithium disilicate was used because the patient had reported a grinding habit...”



Figures 15a-15c: Lithium disilicate ceramic restorations with staining technique.



Figure 16: Frontal view of final restoration on solid working model.

Try-In and Bonding Sequence

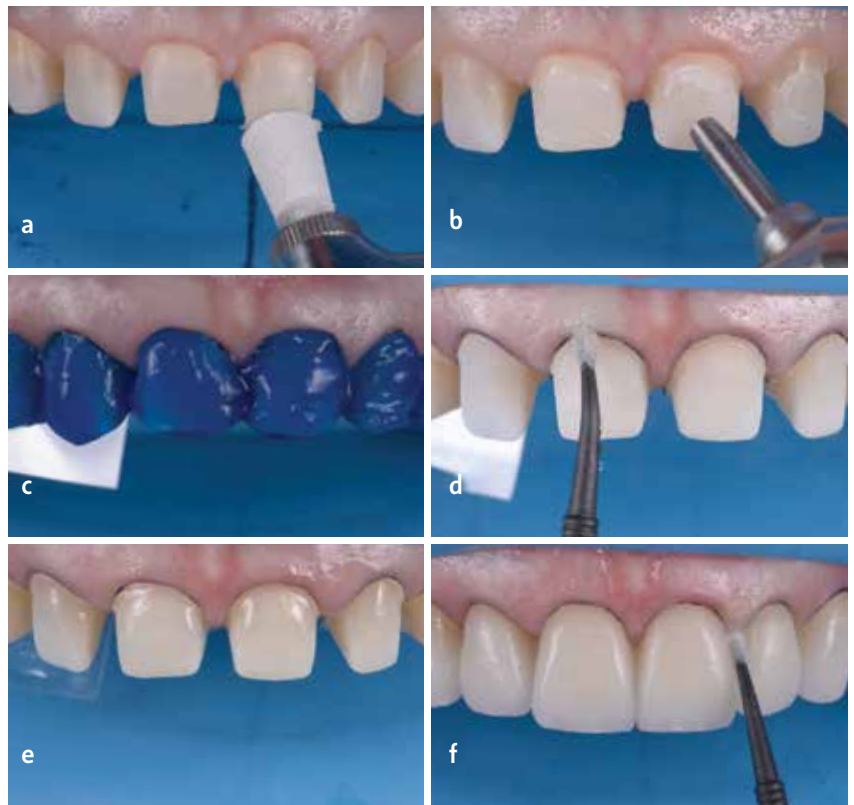
The porcelain veneer restorations were tried in with TR shade paste (RelyX veneer cement, 3M ESPE) to evaluate the margins, proximal contacts, tooth length and width, proportion, contour, smile line, symmetry, occlusion, and color. It is expected that with a precise impression, die-work, mounting, and provisional restorations as a reference, all these parameters will be adequately controlled in the final restorations.

After the patient approved the veneers, the rubber dam was placed and all the veneers were bonded using a total-etch technique and veneer resin cement in the following sequence:

1. The tooth preparations were cleaned with pumice and a webbed prophyl rubber cup and air-particle abrasion was performed with 30- μ silica (Rocatec Soft, 3M ESPE).
2. The preparations were etched with 35% phosphoric acid (Scotchbond Phosphoric Etchant, 3M ESPE) for 15 seconds, rinsed, and coated with adhesive (Single Bond, 3M ESPE).
3. The veneers were etched with 5% hydrofluoric acid (Ceramic Etch, Ivoclar Vivadent) for 20 seconds, then rinsed and dried.
4. Ceramic primer (Monobond S, Ivoclar Vivadent) was applied for 60 seconds, the adhesive was applied on the intaglio (Single Bond), and the veneers were seated using a light-cured resin cement (RelyX veneer) (Figs 17a-17f).
5. Definitive photopolymerization was performed for 40 seconds facially and palatally, and the excess cement was removed with a #12 scalpel (Henry Schein; Melville, NY) (Figs 18-20).

An occlusal guard was fabricated and delivered to the patient at a subsequent appointment to provide nighttime protection for the new restorations.

A suitable environment must be created to achieve minimally invasive preparations without compromising the outcome of the final restorations.



Figures 17a-17f: Frontal views of bonding sequence.



Figure 18: Frontal view of veneers after bonding with resin cement.



Figure 19: Frontal view of final restoration in centric occlusion.

Summary

Minimally invasive treatment continues to increase in popularity. A suitable environment must be created to achieve minimally invasive preparations without compromising the outcome of the final restorations. This article has demonstrated the use of an interdisciplinary treatment-planning protocol to manage conservative preparations with pre-restorative orthodontic treatment. Digital smile design is a useful tool that allows precise clinical and laboratory evaluation, and serves as a communication tool with the patient and with the other specialists. The diagnostic wax-up, mock-up, and esthetic provisional restorations serve as consecutive, critical prototypes that communicate precise minimum tooth reduction and sufficient thickness to the technician in the creation of natural-looking restorations.

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Figure 20: Final patient portrait.



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