THE ULTIMATE AESTHETIC CHALLENGE:

the restoration of a single maxillary central incisor

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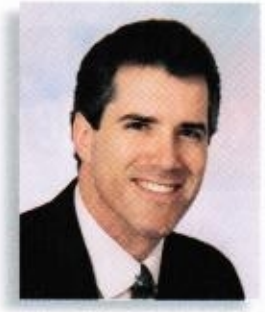

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It has long been thought that the most challenging aesthetic dental procedure is the restoration of a single maxillary central incisor next to an ideal, naturally shaped, and unrestored central incisor. The challenge has always been to attempt to replicate an identical mirror image of the natural tooth and have the final restoration be indistinguishable from its counterpart. Proper shade selection and detailed communication with the laboratory technician is imperative to achieve proper results in these cases.[1] For many years, the "state-of-the-art" restoration was a porcelain-to-metal crown, even though the metal support structure was not translucent and obstructed light transmission, making it difficult to reproduce the light images in natural dentition at the gingiva/prosthesis interface.[2] Then came the age of full-ceramic porcelain restorations and the utilization of porcelain margins to achieve life-like aesthetics. The dental ceramics currently in use exhibit numerous desirable physical properties, including biocompatibility, aesthetics, diminished plaque accumulation, low thermal conductivity, abrasion resistance, and color stability.[3] The increased vitality and "natural appearance" of these all-porcelain restorations, combined with a more conservative tooth preparation, has dramatically improved the aesthetic result that is achievable with today's dental ceramics.[4]

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In the majority of instances, all-porcelain, adhesive-bonded restorations are now the standard by which we restore the anterior, "esthetically-conscious" segment of the mouth. In addition to their highly-esthetic qualities, these restorations are also frequently used in the posterior segments when conservative, less-aggressive treatment modalities are indicated. The concern most often raised with these "bonded" restorations is their strength and long-term durability. The clinical strength of all-ceramic restorations is influenced by several factors, such as core material, the shape of the tooth preparation, and the method of luting.[5-7] The all-porcelain, leucite-reinforced,

before

after

pressed-glass IPS Empress System (Ivoclar, Amherst, NY) demonstrates outstanding life-like esthetics, high tensile strength, fracture resistance, and excellent marginal adaptation when compared with most other all-ceramic systems.[8,9] The dentin substructure of the final restoration is fabricated from a shaded ceramic ingot, which is heated and pressed into an investment material containing the burned-out wax pattern. This substructure or "core" is divested and fitted to the master die. Enamel and incisal porcelains are then built up around the dentin "core" to create the final restoration. IPS Empress' mechanical properties are improved by the presence of leucite crystals, which prevent or reduce the propagation of microcracks throughout

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the glass matrix. The IPS Empress' System features a unique combination of strength and light transmission qualities that resemble the characteristics of natural teeth.[10] When utilized with new generation adhesive agents, combined with highly-filled resin luting cements, dentin bonding allows clinicians to "bond" all-ceramic restorations to tooth structure, creating an integral unit between the restoration and the natural tooth foundation.[11,12] The bond between etched porcelain and the dentin surface, with the utilization of an adhesive agent and resin luting cement, provides high compressive strength and low microleakage.[13] The progress made in the realm of the all-ceramic restoration, along with advances in color matching and laboratory technician skills, has enabled the clinician to achieve an excellent result with this procedure. The "natural appearance" of an all-ceramic restoration, combined with more conservative tooth preparation, has significantly improved the aesthetic outcome that can be achieved and has resulted in the increased public acceptance of the procedure.[11]

CASE PRESENTATION

A 27 year-old physician presented with an extensive direct composite restoration on the labial and lingual surfaces on tooth #8 (Figures 1, 2 & 3). The patient was dissatisfied with the appearance of the existing restoration and the feel of the lingual aspect when compared to tooth #9, yet pleased with the surrounding dentition. The existing composite had been placed many years before as a result of an accident and had been replaced on several occasions due to the discoloration of the restorative material. The patient expressed a strong desire to have a more permanent and natural-looking restoration placed and one which would not discolor with time. After discussion with the patient, the decision was made to replace the defective composite restoration with an IPS Empress full coverage restoration. This material possesses wear resistance similar to natural enamel, kindness to opposing tooth structure, and natural life-like aesthetics; thus, the ideal choice for all-porcelain restorations.[8]

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The patient also expressed a desire to lighten his teeth prior to the final placement of the all-ceramic restoration. The initial phase of the patient's treatment consisted of the fabrication of custom "bleaching" stints from maxillary and mandibular alginate impressions. The material selected to lighten or "bleach" the patient's teeth was Life•Like 10% (Life•Like Dental Products, Santa Barbara, CA). The author has used this material in numerous patients and the incidence of sensitivity or failure to

Figure 1: The patient was dissatisfied with the appearance of the composite restoration on tooth #8.

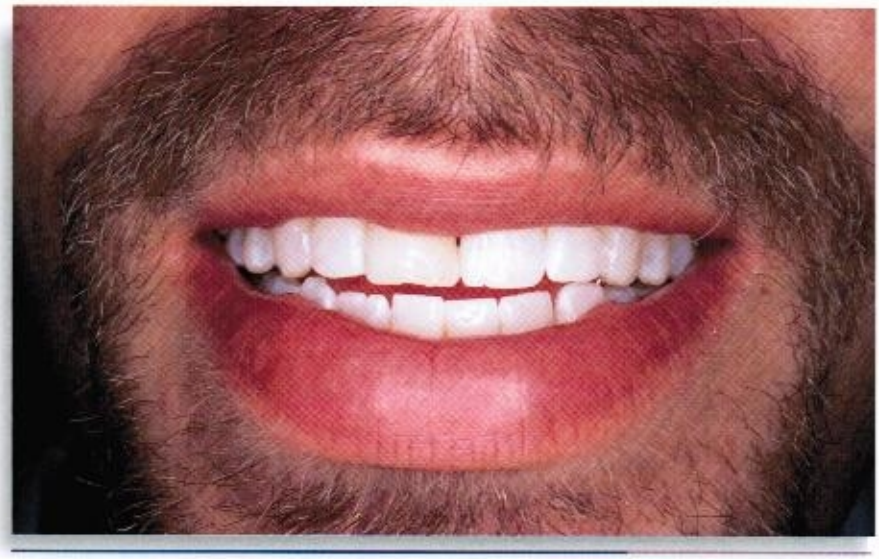

Figure 2: Close-up view of the patient's smile.

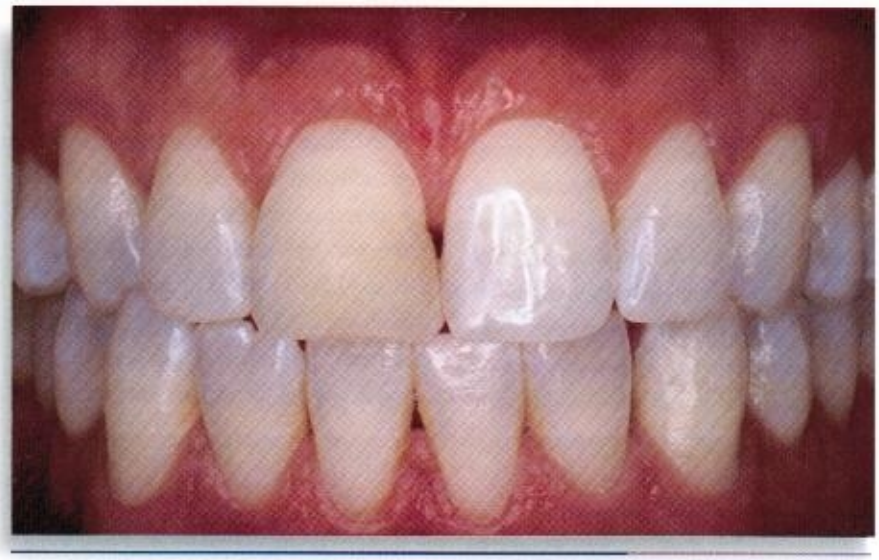

Figure 3: Close-up view of the discolored composite restoration.

lighten is less than one half of one percent (<.05%). The patient was instructed to use the "bleaching" gel for a maximum of three hours per day according to the manufacturer's instructions. The desired level of "bleaching" or lightening was achieved in two weeks. The color of the teeth was then allowed to "settle in" for two weeks prior to the preparation appointment.

PREPARATION PROCEDURE

Custom shade selection was performed at the laboratory in order to achieve all the intrinsic and extrinsic color patterns that the tooth #9 exhibited. Careful attention to the incisal edge pattern, the overall shape, size, as well as facial and lingual contours of tooth #9 was noted in order to accurately duplicate the appearance to tooth #8. Of particular concern was the discrepancy in width between tooth #8 (9 mm) and tooth #9 (10 mm). The dentin lobe pattern of tooth #9 was diagrammed along with the "wrapping" effect of the incisal enamel as it extended down the facial line angles. Initial study models were also provided to the lab technician for reference details.

After anesthesia was obtained via infiltration, the existing composite restoration was removed using a diamond bur. The goal at the next stage was to prepare the tooth with consideration given to the following important factors: first, the minimum preparation/thickness requirements for an all-ceramic restoration; and second, how the dentin lobe pattern and color might influence the final restoration.

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For full coverage anterior restoration, the standard values for the minimum thickness of an all-ceramic restoration bonded to dentin are as follows: 1.0–1.5 mm reduction at the gingival margin, 1.0–1.5 mm of facial reduction, 1.5–2.0 mm of incisal reduction, 1.5–2.0 mm of lingual contact clearance, as well as butt joint margins and rounded internal line angles.[14] Preparation requirements were designed to provide optimal thickness of porcelain for maximum aesthetics and strength, while minimizing tooth reduction.[15] As seen in Figure 3, the patient's adjacent central incisor exhibits a fairly large amount of incisal enamel which "wraps-around" the mesial and distal aspects of the tooth. Upon removal of all the existing composite, a slight amount of extra axial tooth structure was prepared at both the mesial and distal aspects in order to

accommodate the extra amount of "wrap-around" incisal porcelain that would be layered over the sculpted and pressed dentin core. The gingival margin was placed at the height of the gingival crest, on both the facial and lingual. Since there was no metal substructure, there was no need to "bury" or place the margins subgingivally. The final preparation is seen in Figure 4.

Final impressions were taken using a polyether material (Impregum, ESPE-America, Norristown, PA). A provisional restoration was fabricated using a preformed polycarbonate crown (Ion, 3M Dental Products, St. Paul, MN) relined with a provisional crown and bridge material (Snap, Parkell, Farmingdale, NY). The temporary crown was trimmed for marginal adaptation and adjusted for opposing contact, protrusive, and laterotrusive movements. Approximately 0.5–1.0 mm of the provisional material was removed from the facial surface then overlaid and contoured with a microfill resin (Heliomolar, Ivoclar, Amherst, NY) to maximize aesthetics. The temporary restoration was finished, polished, and then cemented with a dual-cure, flexible provisional cement (Provilink, Ivoclar, Amherst, NY).[10] As a final aesthetic enhancement, a superficial white-opaque composite stain (Minute Stains, George Taub Products, Jersey City, NJ) was selectively placed over the facial surface to mimic the "bleached" effect of the adjacent central incisor. This was followed by the composite stain glaze provided in the Minute Stain kit to seal-in the highlighted areas.

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TRY-IN STAGE

The try-in stage is critical for two reasons: first, to accurately determine the fit of the restoration, and second, to determine the final shade of the restoration. The dual-cure, fluoride-releasing, micro-hybrid resin luting cement chosen for final cementation was Variolink (Ivoclar, Amherst, NY). With this system, try-in pastes are available which correctly match all shades of the final cement. The white try-in paste was selected for its aesthetic similarity to tooth #9 (Figure 5). After try-in, the internal surface of the all-ceramic restoration was cleaned and

Figure 4: Final preparation of tooth #8. Note the placement of the final margins at the gingival crest.

Figure 5: Try-in of the IPS Empress Crown with the white try-in paste.

etched for 60 seconds with a 35% phosphoric acid (Ultra-etch, Ultradent Products, South Jordan, UT). This process removes any surface contamination and acidifies the porcelain surface, which increases the efficacy of a silane coupling agent.[4] The acid was then rinsed off thoroughly and the restoration was air-dried. A silane coupling agent (Monobond-S, Ivoclar, Amherst, NY) was then applied to the internal surface of the restoration, left undisturbed for 60 seconds, then air-dried. Silane coupling agents have been shown to increase the bond strength between the porcelain and the resin cement and to decrease microleakage.[17,18] An unfilled resin (Heliobond, Ivoclar, Amherst, NY) was then applied to the internal surface of the restoration and thinned with air accordingly. The restoration was placed in a light-protective container to prevent the premature setting of the unfilled resin prior to final cementation.

Figure 6: Close-up view of the final restoration demonstrates aesthetic harmony, excellent periodontal response, as well as uniform balance and symmetry.

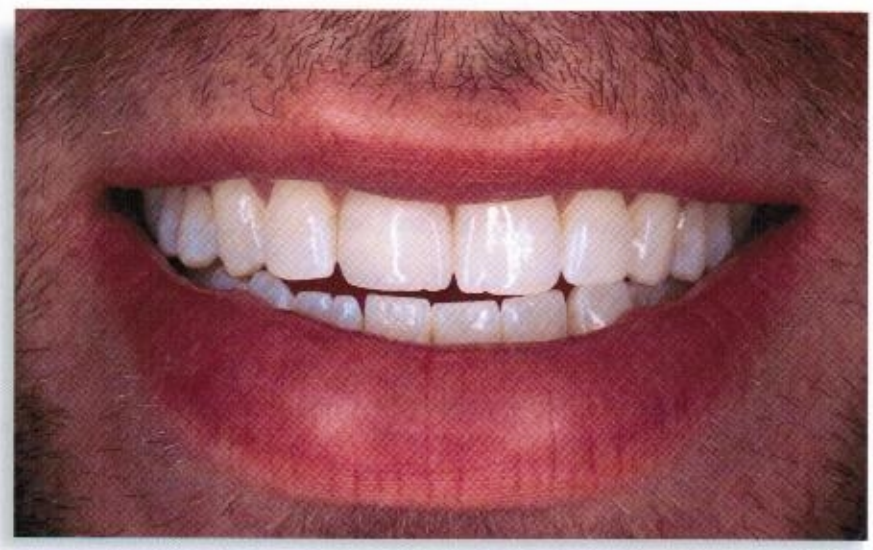

Figure 7: Close-up view of the patient's smile after placement of the all-ceramic restoration.

FINAL CEMENTATION

A rubber dam and retraction cord were placed to obtain complete moisture control. The tooth preparation was cleaned with an antibacterial scrub containing chlorhexidine (Concepsis, Ultradent Products, South Jordan, UT), rinsed, then dried. The 35% phosphoric acid etchant, noted previously, was then applied to the entire preparation for 15 seconds, rinsed, then lightly air-dried, so as not to dessicate the tooth. Tubulicid Red (Global Dental Products, North Bellmore, NY) was placed on the preparation for its antibacterial, cleansing, and rewetting properties. The preparation was lightly air-dried, then primed (Optibond, Kerr, Orange, CA) utilizing several applications. The tooth was lightly air-dried, then followed by the application of Optibond Dual-Cure adhesive (Kerr, Orange, CA). The crown was filled with the corresponding white shade of cement and seated completely. Excess cement was removed first with a rubber tip instrument followed by a brush tip, then spot-cured for 10 seconds each from both the facial and lingual surfaces with a 3 mm light tip. Additional excess cement was then removed. A de-oxygenating agent (De-Ox, Ultradent Products, South Jordan, UT) was applied to all margins and final curing was completed from both the facial and lingual aspects with an 8 mm light tip for two minutes each.

The occlusion, laterotrusive, and protrusive movements were checked and adjusted after the rubber dam was removed. Final finishing in the traditional manner was completed using fine carbide and diamond finishing burs, finishing strips, and polishing cups and points. The final restoration seen in Figures 6 and 7 demonstrates aesthetic harmony, excellent periodontal response, as well as uniform balance and symmetry. The marginal integrity of the restoration is indistinguishable from the surrounding dentition. The patient was extremely pleased with the final result (Figure 8).

DISCUSSION

This case presented an interesting challenge: to duplicate the overall appearance of the adjacent central incisor that was 1 mm narrower than the width of the tooth being restored. Neither the author nor the patient wanted to involve tooth #9 with either a direct or indirect restoration in order to add an extra 0.5 mm to the mesial surface to compensate for the width of tooth #8. To give the illusion that tooth #8 was identical in all proportions to tooth #9 involved the strategic placement of facial line angles, surface features and textures in order to mimic the appearance to tooth #9. The preparation design was equally important to provide the proper amount of reduction for the final restoration. An inspection of all contours and proportions of tooth #9 from gingival to incisal, both facial and lingual, was performed and carefully translated to tooth #8 during all phases of the crown development. The layered porcelain technique was used over the pressed dentin substructure to replicate the characteristics of tooth #9. Extrinsic stains were then added to mimic the bleached appearance to tooth #9. Utilizing all these factors, the final result demonstrates outstanding aesthetics and a mirror-image effect to tooth #9.

CONCLUSION

The ultimate aesthetic challenge is becoming easier through the advances made in all-ceramic restorative materials. The aesthetic, natural, and vital appearance seen in the final restoration (Figures 7 and 8) can be achieved by means of clinical and laboratory skills and the proper communication between these persons. The strength, marginal adaptation, and vitality of the current porcelains available combined

with state-of-the-art adhesive bonding techniques has provided dentists with the ability to easily replicate even the most difficult of restorative situations. High quality, life-like restorations that will give the patient many years of aesthetic confidence and durable function are possible when all factors of the patient's restorative treatment are carefully analyzed prior to the initiation of treatment. Knowledge of the multitude of restorative materials and systems presently in the dental marketplace and their applications to specific dental situations is essential if the clinician is to provide his/her patient with the best type of treatment. The ability to successfully manage any restorative situation, from simple to complex, as previously described, is the responsibility of all of us presently caring for and treating patients.[19] The final outcome achieved in the previous case not only met and satisfied, but exceeded the criteria desired by both the author and the patient.

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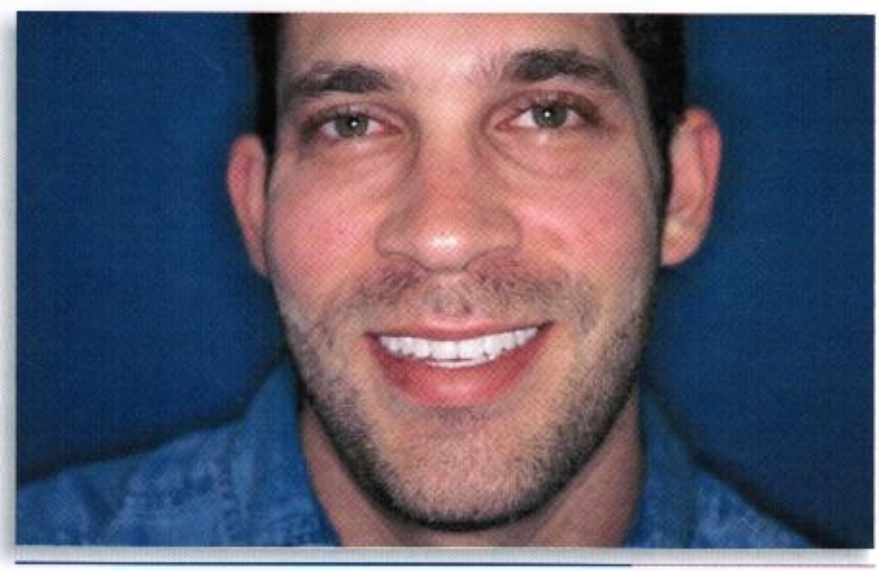

Figure 8: The patient was extremely pleased with the final result.