



The Art of Matching Anterior Porcelain Restorations: A Clinical Case Report

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ABSTRACT Clinicians are constantly challenged with matching one or two incisors to the remaining natural teeth because of the multidimensional properties of color and shape. Single-shade restorations will not adequately match the natural tooth structure and, therefore, will not satisfy most patient expectations. This article describes the steps involved in treatment planning, treatment, laboratory communication and materials for the replication of natural polychromicity to restore and match three incisors to the remaining natural teeth.

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Conflict of Interest
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Advances in dental technology and dental materials have enabled dentists and technicians to restore teeth and enhance smiles in ways once thought to be unattainable. With the ability to restore teeth without metal came the introduction of stronger restorative materials and adhesives.

One of the most difficult challenges facing dentists is matching anterior porcelain to natural anterior teeth. Achieving symmetry of shape, color, value, texture and translucency can be a challenging task. Proper soft tissue control, tooth preparation, good understanding of materials and their application and clear communication with a skilled ceramist are necessary to achieve a predictable esthetic outcome. Porcelain veneers are a conservative treatment modality to enhance a patient's smile, and one that has a high success rate.¹

When all-ceramic restorations are preferred for an endodontically treated anterior tooth, metal posts may negatively affect the esthetic results.² With regard to esthetic concerns, nonmetal posts render esthetic superiority over metal posts. A wide range of esthetic posts is commercially available, such as fiber-reinforced composite resin posts and yttrium-stabilized, zirconia-based ceramic posts.³⁻⁶

Zirconia is currently a widely used material because of its favorable chemical and physical properties, as well as its esthetic advantage of a color similar to that of natural teeth.⁷ Ceramic posts allow better light transmission in the apical and central portions of the crown than cast metal posts; however, they are not as strong.

The purpose of this report is to describe the steps involved in treatment planning, treatment, laboratory communication and

materials for the replication of natural polychromicity to restore and match three incisors to the remaining natural teeth.

Clinical History

The patient was a 44-year-old European male with an unremarkable medical history. He presented with a porcelain-fused-to-metal (PFM) crown on the right central incisor, which had been placed about 20 years prior, following root canal treatment (RCT) and subsequent cast post placement. He had a discolored and worn-down composite restoration on tooth No. 9. He was caries free, had healthy gingival tissues, excellent oral hygiene and had no signs or symptoms of temporomandibular disease. The patient desired a more pleasing smile, but he wished to be treated conservatively and maintain the natural look of his teeth. He emphasized his wish for the treatment not to change his appearance significantly, and his desires were taken into account in the treatment.

Diagnosis

Upon clinical examination, periodontal health, muscles and joints, caries and all other soft and hard tissues were within normal limits. Mild gingival recession (2-3 mm) was diagnosed on some of the teeth and the patient was made aware of it. Gingival grafting was suggested, but the patient opted for no treatment because the recession wasn't causing any esthetic concern. The patient's smile was not esthetically pleasing due to several factors. The right central incisor had asymptomatic root canal treatment and a cast metal post that was contributing to significant darkening of the tooth. The PFM on the tooth had an overly opaque and monochromatic appearance and did not match the adjacent natural teeth. Discoloration was evident and metal was visible at



FIGURE 1. Preoperative full-face view.



FIGURE 2. Preoperative retracted frontal view showing an opaque monochromatic PFM on No. 8 and discolored large composite on No. 9.



FIGURE 3. Preoperative retracted right lateral view.



FIGURE 4. Preoperative retracted left lateral view.

the gingival margin with compromised esthetics. The left central incisor had a discolored and worn-down monochromatic class IV composite restoration. The interdental tissues between the right lateral and right central incisors, as well as between the right central and left central incisors, were missing. This was in addition to the generalized dark shade of the teeth, which were polychromatic and had several maverick colors (FIGURES 1-4). In light of these problems, a decision was made to proceed with esthetic restorative treatment to correct them. Radiographically, there were no significant findings and the patient presented with adequate bone levels.

Treatment Plan

Different treatment options were presented to the patient. Because of the large-sized post and inadequate remaining tooth structure on tooth No. 8, the patient was informed of the guarded prognosis and possible future root fracture. He was thus offered the option of extracting tooth No. 8 followed by immediate

surgical placement of a root-form implant supporting a zirconia crown on a zirconia custom abutment. The patient opted to keep tooth No. 8 and to replace the previous PFM. The patient was offered a smile makeover through veneering more anterior teeth, but he wanted to keep his natural look. Accordingly, the elected treatment plan included replacing the PFM on the right central incisor, veneering the left central incisor, class III composite restoration on the mesial of the right lateral incisor and bleaching. The patient was accepting of the current look of his teeth and wanted the new restorations to mimic the natural characterization of his teeth, which guided the treatment elected.

In order to address the patient's chief esthetic concerns, the plan included the following elements:

Development of a composite mock-up on the study casts to evaluate proper tooth morphology and tooth length for better esthetics and proper gingival contours. This was presented to the patient to assist in determining the course of treatment.



FIGURE 5. The old PFM crown was removed revealing the discolored root and dark tissue margin. Preparation of No. 9 extended 0.5 mm subgingivally on the facial and the gingival proximal area extended lingually at the crest of the papilla.



FIGURE 6. Stump shades were chosen with the stump guide in view for laboratory use.



FIGURE 7. Full-smile view showing the temporaries to guide the laboratory for the length and form of the final restorations.

The composite mock-up was used to fabricate the following:

- Sil-Tech putty (Ivoclar Vivadent AG, Amherst, N.Y.) anterior incisal template.
- A reduction pinhole preparation guide to help in proper tooth reduction.
- Polyvinyl siloxane putty (Splash!, Discus Dental LLC, Culver City, Calif.) for fabricating accurate provisional from the mock-up.
- Replacement of the cast metal post and PFM on the right central incisor with a zirconia post with pressed ceramic core and porcelain jacket crown (Noritake Dental Supply Co. Ltd., Nagoya, Japan).
- Porcelain veneer (Noritake Dental Supply Co. Ltd.) on the left central incisor to mirror image the right central incisor.
- Class III composite resin bonding on the mesial of the right lateral incisor.
- Fabrication of an occlusal guard.
- In-office bleaching using Zoom 2 whitening system (Discus Dental LLC).

Treatment

Prior to the teeth preparation appointment, a diagnostic wax-up of the right central incisor and the left central incisor was created to analyze the case. On the study model, the right central and left central incisors were built to the planned contour using a chairside, light-cured composite.⁸ Two sets of a silicone putty index were fabricated, one to be used as a stent for chairside provisional fabrication and the other as a preparation guide.⁹

Preparation

The patient was anesthetized via local infiltration with Septocaine with 1:100,000 epinephrine (Septodont, New Castle, Del.). The old PFM crown and cast metal post were removed with diamond and carbide burs, followed by the Christensen crown remover (Hu-Friedy, Chicago) and automatic crown and bridge remover (J. Morita USA Inc., Irvine, Calif.). The degree of tooth discoloration determined how much tooth structure to remove at preparation time. It is preferable to treat discoloration chairside, so that the final result will be more predictable. This prevents the less predictable step of masking underlying tooth structure with porcelain. Because of the dark color of the endodontically treated right central incisor, bleaching was done to lighten the existing preparation color. The old post and core were removed and the tooth was internally bleached. Care was taken to seal the coronal aspect of the root canal. Shoulder preparation margins on the right central incisor were refined using a KS1 diamond bur (Brasseler USA, Savannah, Ga.) to full depth 1.2 mm circumferentially and then with a fine-grit end-cutting bur (Brasseler USA). Internal line angles were rounded using a KS3 fine-grit diamond bur (Brasseler USA). Marginal placement was at 2.5-3 mm from the osseous crest as determined through osseous sounding. Osseous sounding provided a stable reference to minimize the chance of biological width invasion

and direct location of interproximal contact, thus increasing the predictability of subgingival margin stability. The margins were 0.5-0.75 mm subgingival. Placement of interproximal contacts at 4.5 mm from the osseous crest also minimized the possibility of “black triangles.” Slight discoloration was still present at the gingival margin, leaving the stump too dark.¹⁰ Our goal was a brighter stump shade, such as A1. The facial aspect of the tooth was slightly prepared 1 mm above the prepared margins and a thin layer of pink opaquer was applied on the tooth to block out the discolored tooth structure.¹¹⁻¹⁴

The post space was prepared using Peeso reamers (Premier Dental Products, Plymouth Meeting, Pa.). Preparation of the left central incisor was guided by reduction templates (pinhole preparation guide, Shofu Dental, San Marcus, Calif.). The preparation was extended 0.5 mm subgingivally with a 1 mm chamfer margin on the facial, and the lingual margins were placed at the incisal marginal ridge for maximum strength of the tooth and the restoration. Lingual margins should not be placed in the lingual fossa, which is the area with the highest concentration of stress on the entire tooth.^{15,16} The tooth was prepared in such a manner as to give the laboratory 2 mm of incisal and 1.5 mm of facial room to develop subtle internal characterization with the porcelain. The gingival proximal area extended lingually at the crest of the papilla to provide adequate porcelain to eliminate black triangles (**FIGURE 5**).



FIGURE 8. Try-in of the zirconia crown on tooth No. 8 showed that it was higher in value. Custom staining was done to match the rest of the teeth.



FIGURE 9. The porcelain veneer was bonded to No. 9. Temporary restoration was removed from No. 8 to try in the zirconia post with pressed ceramic core. Note insufficient remaining tooth structure indicating guarded prognosis; however, adequate ferrule was present all around.



FIGURE 10. Postoperative radiograph showing zirconia post and porcelain jacket crown on the right central incisor.

Polishing of the preparations was completed with rubber cups and ceramiste points (Shofu Dental). A small amount of gingival contouring was also done with electrosurge (Parkell Inc., Farmingdale, N.Y.) prior to taking the final impression. Stump shades were chosen and photographs were taken of the preparations with the stump guide in view for laboratory use (FIGURE 6).

The right lateral incisor was bonded mesially and palatally with renamel composite (Cosmedent, Chicago) after removing the decay and the previous leaking palatal amalgam. Shade A1 with some maverick colors including dilute white and ochre were added to mimic the patient's natural dentition.

The final impression was taken (Impregum, 3M ESPE, St. Paul, Minn.), blowing the impression material into the sulcus. Using the polyvinyl siloxane impression off the mock-up study casts and with the use of Luxatemp shade A1 (Zenith/DMG, Englewood, N.J.), the provisional restorations were made, trimmed, polished and cemented on the patient's teeth with clear TempBond (Kerr, Orange, Calif.). They were shaped to achieve proper contours and margins to evoke good gingival and papillary response. Anterior, lateral and protrusive movements were checked for contact and function. The incisal end-to-end position was also evaluated for proper function.

The patient came the next day for his postoperative appointment. He was pleased with his new smile and needed only minor



FIGURE 11. Preoperative full smile.



FIGURE 12. Postoperative full smile.

adjustments. The author critiqued the provisional restorations and noted that the incisal edges needed to be lengthened. An alginate impression of his upper provisionals was made, poured up in stone and sent to the laboratory. Photographs were taken of the provisional as well to facilitate laboratory communication.

The patient's teeth were bleached with Zoom 2 whitening system (Discus Dental LLC) and he was scheduled to come in for shade selection, where a color map drawing and photographs, along with the shade guide, were taken.

Laboratory Instructions

A detailed prescription was sent to the laboratory, including upper and lower full-arch polyvinyl siloxane impressions, centric bite registration record, upper cast with the provisional in place, stump and tooth shade selection, color mapping and characterization instructions and all required digital images on a compact disc.

The ceramist was asked to increase

the length of the final restorations using the cast of the provisional as a guide to improve the smile line and provide a more pleasing smile (FIGURE 7).

Try-in

After the restorations were completed, they were tried in (FIGURE 8) and were evaluated for marginal fit, contours and color. Some shade-matching challenges were anticipated because of the pure opaque white nature of the zirconia post and the pressed ceramic core. When dissimilar restorative materials are used, it is important to establish similar values before any addition of chroma is made. Excellent communication with the laboratory, with a mutual understanding of both clinical and technical challenges, will facilitate excellent treatment outcome.

The veneer for the left central incisor was placed and tried in with RelyX try-in paste shade Tr (3M ESPE). Then 1:1 digital photographs were taken and both the ceramist and the author mapped out on the



FIGURE 13. Postoperative retracted frontal view.



FIGURE 14. Postoperative retracted right lateral view.



FIGURE 15. Postoperative retracted left lateral view.



FIGURE 16. Preoperative close-up view.



FIGURE 17. Postoperative close-up view.



FIGURE 18. The patient's new radiant and confident smile.

images the enhancements required. Custom staining was done and meticulous attention was given to shade, value, outline form, contours, surface anatomy and texture.

Cementation

After anesthesia was administered, the temporary restorations were removed and the porcelain veneer of the left central incisor was tried in. After obtaining consent from the patient, the decision was made to bond the veneer. The preparation was air-abraded with 50 micron aluminum oxide powder using the MicroEtcher (Danville, San Ramon, Calif.) to remove any remaining cement and to obtain a fresh, roughened surface for bonding.¹⁷

The tooth was then etched with 37% phosphoric acid for 15 seconds, rinsed with water and moistened with a cotton pellet dampened with Gluma desensitizer (Heraeus Kulzer, South Bend, Ind.).¹⁸ Next, the preparation was coated with a dentin primer and adhesive (Optibond Solo Plus, Kerr) for more than 20 seconds, air thinned and light cured. The porcelain veneer was silanated (Ultradent, South Jordan, Utah)

and when ready, a coat of prime and bond NT was applied to the inner surface. RelyX luting cement Tr shade (3M ESPE) was used to bond the tooth. The restoration was then cured with 501 optilux light (Kerr) for 3 seconds. Excess cement was removed and DeOx glycerin gel (Ultradent) was applied to the margin to avoid an oxygen-inhibited layer. Then the tooth was light cured for an additional 40 seconds on the facial and the lingual. Excess cement was carefully removed using a Bard Parker scalpel No.12 (Aspen Medical, Caledonia, Mich.). The margins were polished with Enamelize diamond polishing paste (Cosmedent) and prophyl cup (FIGURE 9). The occlusion was evaluated to ensure light centric contact and even contact on excursions.

The zirconia post with pressed ceramic core for the right central incisor was tried in and then bonded using RelyX Unicem resin cement (3M ESPE). Ultrapack 000 and Ultrapack 1 (Ultradent Products Inc.) retraction cords were placed after being impregnated in hemodent (Premier Dental Products). An impression was made (Imperium,

3M ESPE, St. Paul, Minn.), blowing the impression material into the sulcus of the right central incisor. A new photograph of the stump shade of the right central incisor was taken. The temporary was then recemented using clear TempBond.

A few days later, the porcelain jacket crown of the right central incisor was tried in. Photographs were taken to modify it to mirror image the left central incisor and match the adjacent teeth. The same steps were followed with the try-in of the veneer on the left central incisor. The temporary crown was then recemented using TempBond and the porcelain jacket crown was sent back with photographs to the laboratory to refine the shade. When the patient returned for insertion, the crown was tried in to confirm the fit. It matched the veneer on the left central incisor and adjacent teeth. The patient was pleased with the outcome and approved the final restoration for placement.

It was cemented using RelyX Unicem resin cement. Excess cement was removed and the margins were polished with Enamelize and prophyl cup (FIGURE 10).

The occlusion was adjusted in the centric occlusion and the eccentric excursions. Even contacts on the central incisors in protrusive movement were established. Adjusted surfaces were polished using the Dialite polishing system (Brasseler USA). An occlusal guard was fabricated and delivered to the patient.

Summary and Conclusion

The esthetic enhancement of this patient's smile was accomplished with a zirconia post, pressed ceramic core and porcelain jacket crown on the right central incisor and a porcelain veneer on the left central incisor mimicking the right central incisor. The restorations

blended well with the existing dentition, resulting in improved esthetics. With the attention to detail and extra efforts taken by the clinician to diagnose, treatment plan and execute the necessary steps, a satisfying functional and cosmetic result was achieved (FIGURES 11-17). This also necessitated a collaborative relationship between the dental laboratory technician and the clinician. The patient was pleased with the esthetic outcome (FIGURE 18).

Esthetic treatment can be challenging, especially when combining different types of restorations for maxillary incisors, but proper treatment planning, execution and team collaboration can ensure treatment success and patient satisfaction. ■

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