Conservative cosmetic dentistry post-trauma

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Traumatized teeth can bleed internally, causing discoloration over time. When this occurs in the smile zone, masking the dark colorations can present challenges when attempting to practice conservative cosmetic dentistry. Implementing nonvital bleaching can significantly improve the dark colorations of the traumatized teeth and support very conservative cosmetic dentistry. Effective communication with the ceramist is essential to ensure the desired results. This article presents a case involving trauma with delayed root canal therapy on tooth No. 9, which produced a very dark front tooth, and the conservative treatment plan chosen to correct it through the use of nonvital bleaching and feldspathic veneers requiring zero or minimal preparation.

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Treatment of only 1 or 2 teeth in the smile zone can present cosmetic challenges in blending with the natural dentition.[1] When treating traumatized dark teeth, the balance between cosmetics and practicing conservative dentistry amplifies these challenges. Historically, dark teeth have been aggressively prepared to allow for restorative materials to block out the dark color. This article will present a case with nonvital bleaching and the fabrication of feldspathic veneers requiring zero or minimal preparation in order to conserve as much healthy tooth structure as possible while producing an excellent cosmetic result.

Case study

A 20-year-old woman presented with a single dark upper front tooth (Fig. 1). She reported that the tooth (No. 9) had been fractured after a fall at age 10 while playing softball. Over the following 10 years, she reported having the tooth filled 4 times, and a root canal completed 6 years after the incident.

Tooth No. 9 presented with evidence of previous internal bleeding due to trauma and was much darker in color than the natural dentition.[2] Additionally, tooth No. 8 presented with a discolored facial composite and a gingival defect in the enamel producing asymmetrical gingival architecture. The incisal edges of the 2 teeth were uneven and the widths were not equal (Fig. 2).

The patient requested a longer lasting cosmetic dental treatment to address the discoloration of tooth No. 9, as well as correction of the asymmetrical gingival architecture of teeth No. 8 and 9.

Clinical evaluation

Complete intra- and extraoral examinations were completed that included an evaluation of the hard/soft tissues, temporomandibular joint, caries risk, periodontal health, occlusion, attrition, orthodontic class, crowding, and condition of existing dental restorations. Radiographs were obtained to evaluate supporting structures and existing dental restorations, to assess caries, and to verify the integrity of the existing root canal of tooth No. 9 (Fig. 3). A cosmetic photo series was acquired with study models for records of preoperative conditions and evaluation with the ceramist (Fig. 4).

Tooth No. 9 presented with an existing root canal without any obvious pathology and a mesial incisal lingual facial composite with a chipped mesial incisal corner. The existing shade of tooth No. 9 was D-3 (VITA Classical shade guide, Vident), relative to the remaining natural dentition of B-1 (Fig. 5). The existing facial composite on tooth No. 8 was stained and breaking down along the margins. The mesiodistal widths and edge positions of the 2 teeth were asymmetrical. No mobility was observed. Periodontal pockets were

Fig. 1. Photograph of smile at initial consult showing darkened teeth No. 8 and 9.

Fig. 2. Retracted close-up view showing discolorations and chipped composite.

Fig. 3. Preoperative radiograph of teeth No. 8 and 9.

Fig. 4. Preoperative cosmetic photo series of patient's mouth.

Fig. 5. Existing shade of tooth No. 9 (D-3).

Fig. 6. Anterior view of mandibular crowding.

2-3 mm. All other existing restorations were in good condition. The patient was in class I molar and canine occlusion and presented with postorthodontic lower anterior crowding with wear on tooth No. 24 (Fig. 6).

Given the mandibular crowding and signs of wear, the patient was scheduled initially to correct the crowding and prevent traumatic occlusion.[3-5] Tooth No. 9 needed to be treated with nonvital bleaching prior to the final restoration in order to determine the minimum restoration thickness needed to conserve as much natural tooth structure as possible, to preserve natural enamel strength, and to provide full enamel bonding.[6] Lastly, the final restorations on teeth No. 8 and 9 needed to be fabricated in porcelain and bonded to recreate proper incisal edge position, symmetry, and color, as well as to provide the needed strength for long-term predictability.[7-9]

Treatment planning

The anterior mandibular crowding was discussed with the patient and a limited orthodontic treatment vs enameloplasty of the lower incisors was proposed. Treatment options to address the patient's chief complaint of discoloration were proposed as a more aggressive preparation to block out the dark color as opposed to nonvital bleaching and a more conservative preparation. The replacement of composite on teeth No. 8 and 9 instead of porcelain veneers was discussed, as well as the advantages and limitations in treating only tooth No. 9. Treating both central incisors would produce symmetry in edge positions and tooth widths. The patient elected to correct the mandibular anterior crowding and proceed with nonvital bleaching and porcelain veneers on both teeth No. 8 and 9.

According to the treatment plan, the correction of the mandibular anterior crowding would be completed with a minor interproximal reduction of the lower incisors and the use of a series of Essix ACE thermoplastic aligners (DENTSPLY International).[10] The nonvital bleaching of tooth No. 9 would be achieved with Opalescence Endo 35% hydrogen peroxide (Ultradent Products, Inc.).[11-15] Then, the existing composite would be removed from teeth No. 8 and 9 and feldspathic veneers (Creation CC, Creation Willi Geller International GmbH) requiring zero or minimal preparation would be fabricated.

This treatment plan addressed the patient's chief complaint while being as conservative as possible, thereby maintaining the strength of the natural enamel to provide long-term predictability.[7] The Essix aligners were chosen to minimize the cost of the anterior crowding correction. The nonvital bleaching was selected to bring tooth No. 9 closer in color to the natural dentition, while minimizing the reduction of the natural tooth structure. Feldspathic porcelain was chosen for its optical characteristics, strength upon enamel bonding, and ability to fabricate very thin restorations.

Clinical technique

After correction of the mandibular anterior crowding, nonvital bleaching was initiated on tooth No. 9. Septocaine (4%) with 1:100 k epinephrine (Septodont, Inc.) was administered, and a rubber dam was placed to isolate tooth No. 9. The existing lingual composite access fill and the gutta percha were removed from the chamber and canal to a depth 2 mm below the crestal bone.[1] The canal was sealed up to the crestal bone with a resin-modified glass ionomer, Ketac Nano (3M ESPE).[16,17] Opalescence Endo was placed in the chamber along with a small cotton pellet. The lingual access was temporarily sealed

Fig. 7. Anterior view showing composite removed from tooth No. 8 and nonvital bleaching of tooth No. 9.

Fig. 8. Shade photo of hydrated teeth.

Fig. 9. Stump shade photo of tooth No. 9.

with Ketac Nano (3M ESPE). Two rounds of nonvital bleaching were completed for 3 days each cycle to achieve the desired whitening; this brought tooth No. 9 from shade D-3 to A-1, as measured by the VITA Classical shade guide (Vident). The stained composite on the facial of tooth No. 8 was also removed (Fig. 7).

The lingual access was then restored by administering the Septocaine and placing a rubber dam to isolate tooth No. 9. The chamber was cleaned out to the previously placed Ketac Nano level, rinsed, and dried. Scotchbond Etchant 35% phosphoric acid (3M ESPE) was applied to the enamel around the lingual access for 5 seconds, then applied to the chamber for an additional 15 seconds, rinsed, and blotted dry with cotton to remove excess water. Two coats of Adper Single Bond Plus Adhesive (3M ESPE) were applied and agitated with a microbrush for 15 seconds. The Single Bond was air-thinned for 5 seconds and light-cured for 10 seconds using an Elipar S10 (3M ESPE) curing light. B1B Filtek Supreme Ultra nanocluster composite (3M ESPE) was layered in 2 mm increments to full contour with incremental curing times (20 seconds each).

On the day of preparation for the veneers, a preoperative cosmetic photo series was acquired along with shade photos of the hydrated teeth for the ceramist. The shade B1 from the VITA Classical shade guide was photographed along with higher and lower valued shade references (Fig. 8). Local anesthetic was not needed due to the nonvital bleaching of preparation of teeth No. 8 and 9. A preoperative impression was acquired with a plastic impression tray and Star VPS vinyl polysiloxane (Danville Materials). The existing class IV composite was removed and tooth No. 9 was prepared for a veneer using a coarse round end taper friction grip high speed diamond bur (799.11, Premier Products Co.). The stump shade of tooth No. 9 was recorded and photographed as *ND1* using the IPS Natural Die Material shade guide (Ivoclar Vivadent, Inc.) (Fig. 9).

An Expasyl gingival extraction system (Kerr Corporation) was placed in the gingival sulcus of teeth No. 8 and 9, and a small cotton pellet was used to tamp the Expasyl down. After 2 minutes, the Expasyl was rinsed, and the teeth dried. Imprint 3 light body vinyl polysiloxane (3M ESPE) was injected into the sulcus of teeth No. 8 and 9 and around the other anterior maxillary teeth. A metal full arch impression tray loaded with Provil Novo Putty Fast Set (Heraeus Kulzer) was seated over the maxillary teeth and held in place for 4 minutes. The impression was then removed and all margins and critical areas were verified. The opposing impression was captured in a similar manner with a metal full arch tray, putty, and a polyvinyl siloxane (PVS) wash. A full arch interocclusal bite record was recorded with Blu-Mousse super-fast bite set registration material, a thixotropic PVS (Parkell, Inc.).

A Kois Dento-Facial Analyzer (Panadent Corporation) was used to facilitate the transfer of the occlusal plane and facial midline registrations to the ceramist. Tooth No. 9 was then temporized using a spot etch direct temporary technique. Tooth No. 9 was spot etched with Scotchbond Etchant for 5 seconds, and rinsed and dried. Adper Single Bond Plus Adhesive was applied, air-thinned and light-cured for 10 seconds using the Elipar S10 curing light. The preoperative impression was loaded with Protemp Plus shade A1 (3M ESPE) in the area of tooth No. 9, then seated in the patient's mouth for 5 minutes. Upon removal of the preoperative impression, the excess temporary material was removed, the impression was occlusion-verified, and then polished with Sof-Lex polishing discs (3M ESPE).

The impressions, interocclusal bite record, all pre- and perioperative photos, and Kois Dento-Facial Analyzer records were sent to the ceramist.

Fig. 10. Opaque bake of veneer on refractory dies of teeth No. 8 and 9.

Fig. 11. Layering of feldspathic porcelain on refractory dies of teeth No. 8 and 9.

Fig. 12. Veneers of teeth No. 8 and 9 polished on stone model.

Fig. 13. Veneers on black surface displaying translucency and characteristics. *Left.* Tooth No. 9. *Right.* Tooth No. 8.

Fig. 14. Veneers on black surface displaying translucency and characteristics. *Top.* Tooth No. 9. *Bottom.* Tooth No. 8.

Fig. 15. Veneers completed on stone model.

Laboratory fabrication

Prior to beginning the case, the clinician and ceramist met to discuss the projected treatment plan and options—including materials and techniques—that could achieve the best result. The photos reviewed included the preoperative full cosmetic photo series, shade photos with multiple shade references (to illustrate chroma, value, and internal characterization), and stump shade photos.

The models were poured in Type IV GC Fujirock EP stone (GC America, Inc.) and mounted for review. This case involved the fabrication of a no-preparation veneer on tooth No. 8 and a minimal preparation veneer on tooth No. 9. Feldspathic porcelain was chosen for the desired esthetics. The refractory veneer technique was used to build this case, a Gellar model was fabricated, and dies were duplicated with Polypour (GC America, Inc.), a pourable vinyl polysiloxane duplicating material. The refractory dies were then poured using Nori-Vest (Kuraray America, Inc.) and cured under pressure. The dies were processed strictly according to the manufacturer recommendation, then seated back into the Gellar model.

Willi Gellar Classic Creation (Creation Willi Geller International GmbH) was the chosen porcelain type for the case. The first "bake" was carried out using a 50% mixture of CL-O and HT-51 as a bonding layer to the refractory and was fired 30°C higher than the typical temperature, which is 920°C, to ensure a smooth bond to the refractory material.

The next bake was an opacious dentin layer to mask the line of the preparation and to begin mimicking the adjacent tooth shade (Fig. 10). The firing temperatures were increased 15°C to accommodate the mass of refractory material. The third bake was California White Dentin and E-57, CL-O, TI-4, and TI-2 (Creation Willi Gellar International GmbH). Mamelon characterization was created by mixing MI-61 with INN-1 and INN-2 and fired. E-57, TI-1, TI-2, HT-51 and SI-02 were layered on the incisal and mid facial areas and HT-51 and HT-52 were layered in the cervical area (Fig. 11). A slight halo was added using a mixture of California White Dentin and E-57 on both restorations for a perfect match. The final firing was a slight correction firing that added slight white stain characterizations to mimic the natural dentition.

The restorations were completed on the refractory dies using diamond impregnated silicone wheels (Axis Dental) and Legabril diamond polish paste (Metalor Technologies USA Corporation) (Fig. 12).

The veneers were divested using glass beads for the bulk of the material and finished with aluminum oxide at very low pressure—less than 1.5 bars. After divesting, the internal surface of the veneers were etched with IPS Etching Gel 5% hydrofluoric acid (Ivoclar Vivadent, Inc.) for 20 seconds then placed in an ultrasonic cleaner for 10 minutes (Fig. 13-15). The case was then packed and sent to the clinician.

Final cementation

Septocaine was administered to ensure patient comfort during delivery and finishing of veneers. The temporary veneer was removed from tooth No. 9 by making a vertical cut through the veneer with the 799.11 diamond bur and using a crown spreader to remove the material. Teeth No. 8 and 9 were then cleaned with pumice and a slow speed rubber cup. The 2 veneers were initially tried in one at a time to verify fit, and then tried in together to verify passive seat and proximal contacts. Once verified, the restorations were tried

Fig. 16. Try-in of veneers on teeth No. 8 and 9 with translucent try-in paste.

Fig. 17. Photograph of postoperative smile.

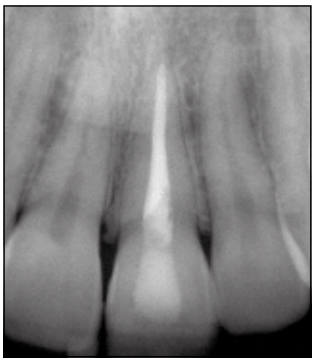

Fig. 18. Postoperative radiograph of teeth No. 8 and 9.

Fig. 19. Postoperative cosmetic photo series of patient's mouth.

in with Rely X Translucent Try-In paste (3M ESPE) to verify incisal edge position, symmetry, midline, hue, chroma, and value (Fig. 16). The veneers were then removed, thoroughly rinsed with water spray, then cleaned with Ivoclean (Ivoclar Vivadent, Inc.) for 20 seconds.

A fourth generation etch-and-rinse bonding system was used for optimal bond strength.[18,19] A single coat of silane RelyX Ceramic Primer (3M ESPE) was applied to the internal surface and allowed to evaporate. Adper Scotchbond Multi-Purpose Adhesive (3M ESPE) was applied to the silane-treated surfaces and air-thinned. Scotchbond Etchant was applied to teeth No. 8 and 9 for 15 seconds, then rinsed with water spray. Excess water was blotted away from teeth No. 8 and 9, leaving the tooth surface moist. Adper Scotchbond Multi-Purpose Primer (3M ESPE) was then applied to teeth No. 8 and 9 and gently dried for 5 seconds. Two coats of the Adper Scotchbond Multi-Purpose Adhesive were applied to teeth No. 8 and 9, and gently air-thinned. The veneers were then loaded with RelyX Translucent Veneer Cement (3M ESPE) and seated with gentle pressure. A small diameter tacking tip was used on the Elipar S10 curing light to spot-cure the veneers in place on the facial surface. The excess cement was removed with microbrushes. The regular curing tip was reapplied to the curing light and each veneer was light-cured for 10 seconds. Glycerin was applied to margins to eliminate the air-inhibited layer and each veneer was then light-cured for an additional 20 seconds. A No. 12 scalpel blade was used to remove excess cement under microscope and Sof-Lex polishing strips and discs were used to finish the margins. The occlusive, excursive, and protrusive movements were checked.

The patient returned 2 weeks later for follow-up, at which point a postoperative cosmetic photo series and radiographs were taken (Fig. 17-19).

Conclusion

Through use of nonvital bleaching, very conservative cosmetic treatment can be used to treat dark teeth. Following proper protocol to seal the canal space is essential to provide for the long-term health of teeth undergoing nonvital bleaching. Communication with the ceramist and understanding of material options is crucial in providing beautiful, natural looking restorations. Conservative tooth preparation allows for complete enamel bonding, maximizing long-term predictability while conserving natural tooth structure.

Author information

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Manufacturers

Axis Dental, Coppell, TX
800.346.3636, www.axisdental.com

Creation Willi Geller International GmbH, Meiningen, Austria
43.5522.76784, www.creation-williegeller.com

Danville Materials, San Ramon, CA
800.827.7940, www.danvillematerials.com

DENTSPLY International, York, PA
800.877.0020, www.dentsply.com

GC America, Inc., Alsip, IL
800.323.7063, www.gcamerica.com

Heraeus Kulzer, South Bend, IN
800.435.1785, www.heraeus-dental-us.com

Ivoclar Vivadent, Inc., Amherst, NY
800.533.6625, www.ivoclarvivadent.us

Kerr Corporation, Orange, CA
800.537.7123, www.kerrdental.com

Kuraray America, Inc., New York, NY
800.879.1676, www.kuraraydental.com

Metalor Technologies USA Corporation, Attleboro MA
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