Aesthetic Zone Challenges: Restoring the Dark Tooth, Part 2
Using Elective Orthodontic Extrusion to Modify Gingival and Bone Levels

This is part 2 of a 2-part article series. Part 1 of Dr. Mechanic’s article was published in the June 2013 issue of Dentistry Today and can be found in our archived articles at the Web site dentistrytoday.com.

**INTRODUCTION**

The restorative dentist is sometimes presented with a patient displaying a dark line or a discoloration surrounding the gingival margin of a crowned tooth. Often the entire porcelain crown cannot mask the discolored underlying preparation, and the entire tooth appears gray. When the crown is an upper anterior incisor, it may seem to almost instantly stand out when the patient smiles. This can cause the patient to be so self-conscious that one will try to avoid opening one’s mouth completely so as to not display the tooth.

Sometimes these restorations can be easily replaced to eliminate the discoloration. However, often because of long-standing gingival inflammation, a dark root or apical tissue migration simply changing the crown will not be the total solution. Periodontal surgery and orthodontic extrusion are valuable tools to allow the dentist to create a healthy gingival environment to surround a new restoration. Once the gingiva has been placed in aesthetic harmony, the color of the underlying root and tooth structure makes the appropriate choice of restorative material extremely critical.

**Material Choices to Optimize Aesthetics**

Color control using a traditional metal crown substructure is very challenging and can result in a dark line at the margin and/or highly chromatic porcelain in the gingival third, as that is where the lamina is very thin. Newer aesthetic materials such as zirconia and lithium discilicate are unpredictable when restoring dark teeth as the discolored underlying tooth, posts, or restorative materials can show through and alter the desired outward appearance.

Captek (Argen) was first introduced in 1994. Its technology allows the dentist to have the aesthetic benefit of an all-ceramic crown, while giving the ceramist the ability to eliminate the negative influence from the underlying preparation materials, and the dark color of the natural or endodontically treated tooth. Captek yields a highly aesthetic restoration by utilizing a warm colored gold composite metallic substructure. It is nonoxidizing, corrosion free, and is internally reinforced for strength, allowing it to be very thin. The final Captek coping contains 84% gold and 16% platinum/palladium which allows it to fuse to porcelain. The gold color and reflectivity of the metal coping allows it to blend with the cervical of the tooth and the soft tissues.

The Captek crown is available in 3 substructure variations which have been specifically designed for different clinical situations. Captek Nano Esthetic Zone (EZ) (Argen) is ultrathin (< 0.2 mm), and it is an ideal choice for restorations in the aesthetic zone as it allows more room for porcelain than other metal or zirconia substructures. Captek crowns are simple to place and can be cemented with either conventional or resin cements.

Research studies have concluded that extremely low-bacterial accumulation gathers around the margins of a Captek crown. It exhibits lower surface energy than tooth structure, making it highly biocompatible and less likely to attract plaque. Further-
more, these restorations have a marginal fit of 14.5 to 17.5 μm, comparable to the best cast gold restorations.

**CASE REPORTS**

**Case 1: Using Orthodontic Extrusion to Realign Gingival and Bone Levels**

The use of elective orthodontic extrusion of teeth as a means to modify gingival and bone levels has been well-documented. Forced orthodontic eruption is a technique for soft- and hard-tissue augmentation based on osteoplastic and orthodontic principles. It was first described in the literature by Heithersay and Lingbergh. Depending on the forces exerted, orthodontic extrusion is able to alter the position of the gingiva and the underlying crestal bone. If greater traction forces are chosen, the tooth can erupt out of the bone, allowing a more solid root ferrule to work with. Forced orthodontic eruption can be used as a tool to correct infrabony defects, repair a gingival margin, change a root position, and/or to achieve a clinical crown lengthening.

There are 2 types of orthodontic extrusion: (1) low-intensity extrusion using less than 30 g of force and (2) high-intensity (rapid) extrusion with forces exerting greater than 50 g.

High-intensity (rapid) orthodontic extrusion is useful when we wish to pull the tooth out of the alveolar bone. The migration of the tissues coronally (bone and gingiva) supporting the tooth is less pronounced, since the rapid movement of the tooth exceeds the capacity for physiologic adaptation. Rapid orthodontic extrusion is indicated for (1) treatment of subgingival and subosseous lesions, especially in the aesthetic zone (caries, fractures, perforation, resorption); (2) treating a restoration that is violating the biological width; (3) situations where surgical extraction is contraindicated (chemotherapy, radiotherapy, biphosphonates); and (4) narrowing a tooth that is too wide such as a canine in the lateral incisor position. The diameter of the tooth can be reduced with the progression of the extrusion, especially with conical roots.

Low-intensity orthodontic extrusion, using less than 30 g of force, can produce approximately one mm of extrusion per week. It stimulates the marginal positioning of the crestal bone and allows the gingiva to follow it. The alveolus being attached to the root by the periodontal ligament is then pulled along with the movement of the root. The ability to change the gingival position via the extrusion of teeth gives the clinician the ability to control dental aesthetics. Traction forces are placed on the tooth, bringing the crestal bone along with it into a new position. The gingiva follows the vertical movement of the tooth and bone. The presence of the tooth allows us to modify the position of the bone and gingiva. The absence of teeth makes these alterations more challenging.

**Diagnosis and Treatment Planning**—Our patient presented with a 3-year-old all-ceramic crown on her upper right central incisor (tooth No. 8) that was discolored at the gumline and had a gingival level apical to that of the adjacent central (Figure 1). From the day it had been placed, she had never been satisfied with the restoration. She simply had accepted it because she was told by the restorative dentist that nothing more could be done. She worked with the public and was embarrassed to smile, trying consciously to avoid displaying the gingival margin.

Upon initial examination, it was difficult to ascertain if simply replacing the crown would be satisfactory, or if the underlying tooth color was the major source of the discoloration. After the existing crown was removed, we were able to visualize and assess the entire clinical situation (Figure 2). The tooth had a previously placed metal post. It had been veneered with a composite resin in an attempt to mask it for the placement of a pressed ceramic crown. However, due to the metal post, the root of the tooth exhibited a black line and had an overall darkness (the tooth had been nonvital for more than 25 years). It was thoroughly explained to the patient that her tooth was highly compromised and if she chose to place a new restoration, there were no guarantees as to how long it would last. The option of an implant was also discussed.

**Figure 5.** The tooth preparation was modified; an impression taken and a new bis-acryl provisional fabricated. A photo of the chosen Vita shade (Vident) was used for reference.

**Figure 6.** An aesthetic Captek (Argen) crown was fabricated to the shape and size prescribed by the provisional restoration.

**Figure 7.** The final restoration delighted the patient. Note: The gingival margin could be easily modified at a later time, if desired.

**Figure 8.** Case 2: A gummy smile, dark gingiva, opaque crowns, canted incisal plane, and misaligned proportions and gingival levels presented real challenges in this case.

**Figure 9.** The long-standing metal cast posts of the endodontically treated teeth left the gingiva dark, creating a demanding restorative aesthetic challenge.

**Figure 10.** The incisors presented with long roots and solid cast posts.

**Figure 11.** The gingival biological width was intentionally violated. The margins were placed where they belonged, regardless of the alveolar bone position.

**Figures 12a and 12b.** After the biological width correction, sutures and new bis-acryl provisionals were placed.

**Figure 13.** The sutures were removed 2 weeks after surgery.

**Figure 14.** The tissue was allowed to heal for 6 months. Healthy fibrous attached gingiva would now provide a healthy environment for the new crowns.
The patient chose to attempt whatever it would take to preserve the natural tooth, and to keep it as long as possible.

Clinical Protocol
A bis-acryl provisional (Luxatemp [DMG America]) was fabricated from a pretreatment template (AFFINITY Crystal [CLINICIAN'S CHOICE]) and permanently cemented to the existing tooth preparation using a one-step resin cement (Embrace [Pulpdent]).

DENTSPLY GAC orthodontic brackets were placed from premolar to premolar. Copper Ni-Ti wire low-intensity extrusion forces of 15 g were placed on the targeted central incisor to move its margin and the surrounding gingival tissue incisally approximately 1.0 mm every 2 weeks. The wire was progressively increased from 0.14 to 0.25. The lower anterior teeth were also bracketed in order to correct minor crowding and to develop ideal incisal guidance (Figure 3). Once the gingival margin was positioned to our satisfaction, high-intensity forces of 50 g were placed for a 2-week period to extrude the tooth out of the bone, providing us with a better ferrule upon which to place the crown margins.

After a total 4 months of orthodontic extrusion, the brackets were removed and a lingual wire was placed from canine to canine. The teeth were left to stabilize for an additional 4 months (Figure 4). The bis-acryl provisional was then removed and the underlying preparation modified to accommodate the new crown.

The combined low- and high-intensity orthodontic extrusion modified the position of the gingival crest (low-intensity) and extruded the root out of the bone, leaving a biologic width of 3.5 mm. This created an ideal situation for placement of the labial crown margin at 1.5 mm subgingivally, thus allowing the gold Captek substructure to mask the dark root structure from showing through the thin gingiva. It also gave us the option of later being able to reduce the gingival crest position, if desired.

The modified preparation with a labial chamfer margin was temporized with bis-acryl provisional, and a final impression was taken using a vinyl polysiloxane (VPS) putty and light body (Honigum [DMG America]) wash technique. A shade was taken (Vita Classical Shade Guide [Vident]) using color-corrected light (Optilume TrueShade [Optident]). A digital photograph was taken of the chosen shade, including the natural teeth as a reference (Figure 5).

A Captek EZ restoration (Figure 6) was then fabricated by our dental laboratory team, described as follows:

The master die was duplicated with Capsil (Argen) and poured with Capvest (Argen) to create a refractory die. A coping was made from pieces of Captek P material and pressed to fit the die. Next, it was tightened in the P press machine, finished to the final shape, and then fired in a porcelain furnace. Captek G material was then added on top of the previously fired P material and fired in the porcelain furnace to create the composite gold substructure. The margins were finished, polished, and then the appropriate porcelain veneering material was applied and baked.

When the Captek restorations were returned from the dental laboratory, the patient was appointed and the crown tried-in in her mouth (without cement) for approval. She was delighted! We pointed out to her that the gingival levels of the 2 centrals did not align perfectly; however, this could be quickly and simply readjusted with a diode laser. The patient loved it the way it was; after many years, there was finally no dark line or gray gingiva evident. At last, she was not embarrassed to smile! (Why take a chance and perhaps make it worse? Great artists know when to stop because they realize that sometimes a final stroke can ruin a masterpiece.)

We proceeded with the final cementation by treating the internal metal surface of the crown with a universal primer (Z-PRIME Plus [BISCO Dental Products]), then permanently cemented with a resin cement (Permacem II [DMG America]) (Figure 7).

Case 2: Elective Periodontal Plastic Surgery to Align Gingival Levels

Diagnosis and Treatment Planning—In this case, our patient presented with very specific requests as to how to change the look of her maxillary anterior teeth (Figure 8). Although her 4 anterior crowns had been placed 14 years earlier, they still appeared to be healthy and functioning. However, she wanted to improve upon the aesthetics provided with the technology that was available at the time. After wearing 3 different sets of upper anterior crowns during a 30-year period, this patient was educated and clear about the changes that she desired. She wished to
improve her “gummy smile,” and she also wanted to eliminate the darkness showing at the gingival margins of the existing crowns. As the teeth were endodontically treated more than 30 years previously, it was unclear whether the metal margins of the crowns were causing the darkness, or if it was the actual underlying tooth/root structure that was discolored. She also wanted to improve the gingival and incisal edge disharmony of the teeth and the incisal cant. It truly is a benefit for a dentist to have a patient who has clear treatment objectives.

Once the existing crowns were removed, it was confirmed that the presence of 4 long-standing metal posts/cores in these endodontically treated teeth had stained and discolored the underlying tooth structure (Figure 9). Radiographs confirmed that the patient’s roots were long and strong, and that the large existing posts would be extremely difficult to try to remove and replace (Figure 10). However, the fact that the roots were long and solid made them suitable to having elective periodontal plastic surgery in order to re-establish a new gingival position to reduce the “gummy smile.”

To electively reposition the anterior gingiva, several essential criteria must be respected. First, by examining the patient’s radiographs, we should assess if we have adequate root length, and verify if the root anatomy is conducive to removing some of the supporting alveolar bone. Remember, we do not want to compromise the tooth and the patient.

When the alveolar bone is reduced by elective periodontal osseous crown lengthening, we must be left with a clinical situation where the connective tissue and the epithelial attachment each occupies one mm (or slightly more). This combined periodontal attachment of approximately 2 mm is referred to as the biologic width. There should always be a free-gingival margin remaining of at least 3 mm of keratinized tissue and an interproximal papilla height of 4.5 mm above the level of alveolar bone.

Following parameters established by a previously lab-fabricated diagnostic wax-up, the gingival margins of the teeth were prepared to their ideal levels (Figure 11). The tooth preparation intentionionally violated the biological width into the gingiva and bone. This exact placement of the margin clearly indicates to the periodontist exactly what the biologic width correction should be. A one-piece, 4-unit bis-acryl provisional (Luxatemp) was fabricated, confirming that the gingival position of the new preparations was at the desired aesthetic level. This provisional also served as a template to illustrate the emergence and tooth position for the periodontist. Elective periodontal osseous surgery was then performed, raising a flap of attached gingiva and adjusting the alveolar bone level to create a biologic width of 3 mm. We choose to create slightly greater biologic width than needed in the event that we would decide to later reduce the gingival margin further with a diode laser. (It is always good to leave your options open.) The attached gingiva was then sutured into a position designed to preserve the interdental papilla. Less than 3 mm existed from the adjusted bone height to the desired papilla height, ensuring that no papilla would be lost to result in producing black triangles (Figures 12a and 12b).

Two weeks later, when remainder of the sutures were removed (Figure 13), the patient expressed how delighted she was with her course of treatment. She had experienced very little discomfort. She also stated that she appreciated that her crown preparation and osseous repositioning were done during the same appointment, eliminating multiple procedures and also giving her immediate aesthetic satisfaction. She was so content with the provisional that she had no issue leaving it in her mouth for 6 months to allow adequate time for the surrounding gingiva to adapt to it and mature.

At about 6 months, when the provisional restoration was removed, she had healthy fibrous attached tissue encircling the teeth (Figure 14).

The biologic width was verified to be 3 mm so the margins of the tooth preparations could be placed 1 mm below the free-gingival margin. This would allow the Captek crowns to further mask the dark root structure. A final impression of the preparations was taken with a VPS putty and lightbody (Honigum). A lower model was taken with an alginate substitute (Status Blue [DMG America]). Then a very accurate bite registration was taken (Luxabite [DMG America]). The new preparations were retemporized with the bis-acryl provisional material, refined and reshaped to the patient’s satisfaction. An impression of the provisional was taken with the alginate substitute (Status Blue). A Vita A1 shade was taken using color-corrected light. A digital photograph was taken of the chosen shade, with the natural teeth included as a reference (Figures 15a and 15b).

Four Captek crowns, following the shape and form of the provisional restorations, were fabricated by our dental laboratory team (Figure 16). As the patient was totally satisfied with the provisional restorations, all the ceramist had to do was to mirror them in the permanent restorations. Using this technique, the need for any laboratory corrections is unlikely.

When the crowns returned from the dental laboratory, the shade was evaluated and they were examined to ensure that the form of the provisional was followed. The patient was then scheduled for the restoration delivery appointment.

The temporary restorations were removed and the Captek crowns were placed without cement for the patient to evaluate. She was ecstatic with the result. The internal metal surfaces of the Captek restorations were treated with the universal primer and permanently cemented to the cleaned prepared teeth with Permace II (Figure 17).

A satisfied patient is our goal and is the greatest reward of aesthetic dentistry. Our patient was thrilled with the shape, incisal edge position, symmetry, midline, and the contour and color of her gingiva. What more can one ask for?!

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References


Dr. Mechanic received his bachelor of science (1975) and doctor of dental surgery (1979) degrees from McGill University. Dr. Mechanic maintains membership in numerous professional organizations, including the American Academy of Cosmetic Dentistry, the Academy for Dental Facial Esthetics, the American Society for Dental Aesthetics, and the European Society of Cosmetic Dentistry. He practices aesthetic dentistry in Montreal, Canada. He also is the cofounder of the Canadian Academy for Esthetic Dentistry, program coordinator of the University of Toronto Advanced Restorative Continuum, and is recognized as a leader in continuing dental education by Dentistry Today. He is the aesthetic editor of Canada’s Oral Health dental journal and is on the editorial board of Dentistry Today. His work has been profiled in magazines, television, and radio. He can be reached via e-mail at info@drmechanic.com.

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