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Conservative Aesthetic Solutions for the Adolescent and Young Adult Utilizing Composite Resins

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With the virtual explosion of aesthetic and cosmetic procedures available to patients today, a rising demand for these services by an information-rich society has led to a growth pattern unlike any seen previously in dentistry. Dental consumers are no longer satisfied with simply having ''white'' fillings but look for restorative options that produce nearly invisible restorations to meet their aesthetic goals. As the dental pendulum swings over the years, more conservative restorative options continue to rise to the top. The terms *less is more* and *minimally invasive* never held more truth for the dental profession than they do today, especially when considering aesthetic treatment options for adolescent and young adult patients.

Frequently, aesthetic dental treatment is viewed as an elective procedure but often, its necessity is a result of a systemic or genetic condition, dental disease, or an unfortunate accident. Regardless of the basis for the procedure, a prudent effort should be made to evaluate the long-term effects of any restorative course taken. Spear [1] outlined four principles of treatment planning that should be held in paramount respect when considering alternatives in daily practice and especially when restoring teeth of a young person. These four principles are conservation, function, aesthetics, and longevity.

Conservation can be defined as seeking a treatment course that satisfies the mutual goals of the patient and the dentist while posing the least long-term harm to the patient. Function relates to the ability of the patient to use the restoration in normal daily activities as though it was the patient's own tooth. Aesthetics lends itself to a restoration that should appear inconspicuous when viewed in the mouth. Longevity yields a treatment that

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should last an acceptable number of years based on the particular treatment goals for the patient.

To this end, clinicians have available two categories of restorative alternatives (direct and indirect materials) for the anterior region that present benefits and contraindications. Considerations include material composition, physical properties, wear characteristics, shrinkage, and compressive strength, among others. The skill of the clinician when executing the preparation design to ensure conservation of tooth structure and applying dentinal adhesives and bonding the restoration, in addition to the technique sensitivity of placing these materials, may contribute to a clinician's decision toward selecting a particular restorative modality.

Direct composites offer dentists the most simple and cost-effective material with which to create an aesthetic change in the anterior portion of the mouth and have reached widespread use within the dental community, but not without a pronounced learning curve. It has been 50 years since Buonocore [2] conceived of bonding to enamel with the introduction of acid etching, and although the resin-based fillings of that period were inferior to those currently available, issues related to the material's properties and handling characteristics and the clinician's skill remain keys to the success or failure of a composite restoration. Dental product manufacturers have developed improvements to the material properties of composites and available bonding agents, enhancing the probability of success when placing direct composite resin restorations. These improvements, coupled with innovative and reproducible placement techniques, can enhance the dentist's ability to use direct composites to create successful and long-lasting restorations.

The following case presentations illustrate five restorative techniques using direct composite resins to achieve the outlined conservative treatment goal: (1) aesthetically restoring two maxillary anterior teeth with fluorosis, (2) reattaching a coronal tooth fragment, (3) creating a full resin veneer crown on a fractured incisor, (4) restoring undersized lateral incisors and closing postorthodontic diastemas, and (5) replacing a congenitally missing maxillary lateral incisor with a fiber-reinforced direct composite bridge.

Case report 1

Examination and background

The patient was a 15-year-old girl referred for evaluation of white chalky spots present on teeth 8 and 9 (Fig. 1). Previous records were obtained from the patient's orthodontist and general practice dentist. The patient's medical history was noncontributory, periodontal status was within normal limits, and there was no radiographic evidence of hard tissue disease. The patient's and her parents' desire was to have an aesthetically pleasing smile through as conservative a treatment as possible. A diagnosis of dental fluorosis was

Fig. 1. Preoperative retracted view of fluorosis areas on teeth 8 and 9.

made and treatment options were discussed, including the use of vital bleaching, microabrasion, and macroabrasion/megabrasion.

Often, if a tooth presents a mild fluorosis, then vital bleaching of the tooth with one of the carbamide peroxide or hydrogen peroxide systems available to the dentist provides good aesthetic results simply by decreasing the contrast between the white spots and the surrounding tooth structure. Teeth exhibiting areas of more moderate fluorosis and involving the superficial enamel layer may benefit from the original microabrasion technique reported by Croll [3], in addition to vital bleaching. On occasion, however, these white opaque areas extend deeper into the enamel layer and may require the use of macroabrasion [4] or megabrasion [5] to remove the offending lesion. This technique involves mechanically eliminating the white spot and restoring with a direct composite material to create a conservative solution.

Technique

No local anesthetic was administered. A course-grit diamond bur (Brasseler USA, Savannah, Georgia) was used with a water spray in a sweeping motion until the white chalky spot was eradicated, and the resulting preparation created a distinct enamel bevel (Fig. 2). The preparation was cleansed before acid etching with 5% sodium hypochlorite on a disposable brush, rinsed for 10 seconds with water, and lightly air-dried. A ''total etch'' technique was employed using a low-viscosity 37+% orthophosphoric acid (Enamil Prep [Ivoclar Vivadent, Inc., Amherst, New York]) for 15 seconds, rinsing with a water spray for 15 seconds, and lightly air-drying (Fig. 3). A single-component dentin bonding agent (Prime & Bond NT [Dentsply Caulk, Milford, Delaware]) was placed according to the manufacturer's directions and cured for 10 seconds with a visible light source (Fig. 4).

A thin layer of a flowable resin (3M/ESPE, St. Paul, Minnesota) was applied with a disposable brush, coating the labial surface beyond the preparation margins, and air-thinned before curing for 10 seconds. A classic

Fig. 2. Diamond bur used to eradicate fluorosis and create bevel.

Fig. 3. Acid etchant applied for 15 seconds.

Fig. 4. Dentin bonding agent applied according to manufacturer's instructions.

layering technique was used, and body shade composite (Filtek Supreme Shade A1B [3M/ESPE]) was syringed into the preparation to replace the removed enamel and blend in with the existing tooth structure (Fig. 5). The composite was manipulated with a flat-bladed instrument (Ash [American Eagle Instruments, Inc., Missoula, Montana]) and cured for 10 seconds

Fig. 5. First layer of composite syringed onto tooth 8.

(Fig. 6). A second, more translucent composite layer was added (Filtek Supreme Shade A1E [3M/ESPE]), and precure contouring was completed with a G-2 ceramist brush (Ivoclar Vivadent, Inc.) that was lightly lubricated with an unfilled bond resin (Heliobond [Ivoclar Vivadent, Inc.]) (Fig. 7). The second layer was cured for an additional 20 seconds from the labial and lingual aspects.

Shaping of the facial surface was accomplished with a 12-fluted, spiral-bladed carbide bur (Brasseler USA) (Fig. 8), and final polishing of the restorations was created using abrasive cups (Astropol [Ivoclar Vivadent, Inc.]) in a light, whisking motion, without water spray, until a high luster was achieved (Fig. 9). The final restorations exhibited a chameleon-like effect by using only two shades of composite (Fig. 10).

Discussion

When examining the restorative options in the treatment of dental fluorosis, conservation of tooth structure is the over-riding principle. Systematic consideration of the most conservative choice first (vital bleaching) and

Fig. 6. Composite manipulated with a flat-bladed Ash instrument.

Fig. 7. Second layer of more translucent composite added and contoured with a flat, chisel-shaped ceramist brush.

Fig. 8. After curing, initial shaping is completed with a 12 fluted, spiral-bladed carbide bur.

Fig. 9. Final polish achieved with abrasive cups.

progression to microabrasion and marcoabrasion as required can only benefit the patient. In this case, the ability to remove the fluorosis-induced chalky spots in a conservative fashion allowed restoration of the tooth using a direct composite resin in an aesthetic and functional manner.

Fig. 10. Final retracted view of composite restorations on teeth 8 and 9.

Case report 2

Examination and background

The patient was a 9-year-old boy who had fallen on a gymnasium floor and fractured the incisal one third of the clinical crown on tooth 8 (Figs. 11 and 12). The patient's medical history was noncontributory. Periodontal tissues were within normal limits. Clinical examination of the patient and radiographic evidence revealed no pulpal exposure or bony involvement. The tooth was asymptomatic, except for mild sensitivity to air. The patient presented with the fractured tooth fragment wrapped in a wet facial tissue.

Fig. 11. Preoperative full-face view of patient with fractured tooth 8.

Fig. 12. Retracted view of fractured tooth 8.

The coronal fragment was approximated and aligned with the fractured clinical crown to establish the ability to reposition the broken portion. After consulting with the parents, a decision was made to reattach the tooth fragment using a dentin bonding procedure. Reattachment of a coronal fragment, when possible, is a highly desirable alternative because it falls within the conservative treatment philosophies previously described. It simplifies the treatment, facilitates an aesthetic result, and minimizes the amount of steps necessary to create a long-lasting restoration [6–10].

Technique

The patient was anesthetized using 0.9 mL 2% mepivacaine hydrochloride with 1:20,000 levonordefrin. With a course-grit diamond bur (Brasseler USA), a 360° circumferential chamfer-type preparation was made in the enamel portion of the fractured crown, with care taken to not alter the horizontal dentinal component (Fig. 13). The coronal fragment was prepared in a similar fashion, with care taken to not alter the horizontal dentinal area where the two pieces would fit together (Fig. 14). A clear Mylar matrix band (Contour Strip [Ivoclar Vivadent, Inc.]) was placed around the cervical collar of the tooth and secured by flowing an unfilled bond resin (Heliobond) on the outside of the strip and the adjacent teeth and gingival tissues. A more detailed description of the matrix is presented in cases 3 and 4. After cleansing the preparation and the coronal fragment with 5% sodium hypochlorite for 10 seconds, rinsing with water, and air-drying, the preparation and the fragment were etched with a 37% orthophosphoric etchant for 15 seconds (Fig. 15), rinsed with a water spray, and lightly air-dried.

A single-bottle dentin bonding agent was applied to the fragment and the preparation according to the manufacturer's directions and cured with a visible light source for 10 seconds (Fig. 16). A light-curable, resin-based luting cement (Variolink [Ivoclar Vivadent, Inc.]) was syringed onto the tooth and the coronal piece, which was fit to its original position, and the entire segment was cured for 20 seconds from the labial and lingual aspects of the

Fig. 13. A 360° circumferential chamfer preparation was made in the enamel portion of the fractured clinical crown.

tooth (Fig. 17). The matrix was removed and initial shaping was done with a fine diamond bur (Diatech USA, Charleston, South Carolina) (Fig. 18); 12-fluted, spiral-bladed carbide burs (Brasseler USA); and abrasive cups (Ivoclar Vivadent, Inc.). Figs. 19 and 20 illustrate the final result. At 6-, 12-, 18-, and 24-month follow-up examinations, the tooth fragment remained intact, was aysmptomatic, and displayed excellent aesthetic qualities. Figs. 21 and 22 were taken at 18 months postoperatively.

Discussion

A number of different options are available when deciding how to restore a fractured anterior tooth, depending on one's philosophy and knowledge of

Fig. 14. The coronal fragment was prepared with a similar bevel, being careful not to alter the horizontal dentinal component.

Fig. 15. After placing the Contour Strip matrix and securing with Heliobond, the entire preparation is acid etched for 15 seconds.

Fig. 16. A dentin bonding agent was applied to the etched enamel and dentin on the preparation and the tooth fragment with a microbrush.

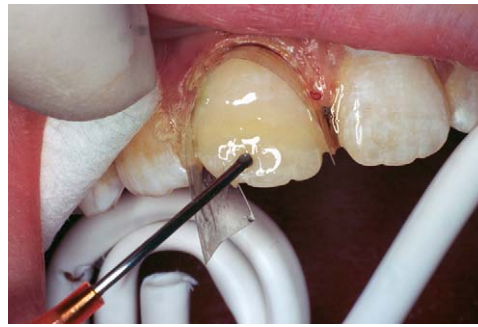

Fig. 17. The coronal fragment is reattached using a light-curable, resin-based luting cement and cured for 20 seconds from the labial and lingual aspects. Additional flowable resin is applied to fill in the bevels.

Fig. 18. Postcure finishing is initiated with a fine diamond bur, followed by 12-fluted, spiral-bladed carbide burs, and polished with abrasive cups.

aesthetic materials and techniques. Considerations based on age are important, especially for children in the mixed-dentition stage who frequently have large pulp chambers and open apicies due to their lack of dental development. Although one might consider restoring a fractured tooth such as in case 2 with a porcelain veneer, this option was not presented at this age due to the unstable dentition and the desire to be ultraconservative. The use of a light-cured direct composite would have been an excellent choice if the tooth fragment had been lost (this option is discussed in case 3). When a traumatic event causes a tooth to become fractured and the coronal fragment is retained, it has been shown that an appropriate and successful treatment choice is to perform a bonding procedure to reattach the fragment. In addition, proper preparation of the tooth and coronal fragment has a positive effect on the success of the bonding procedure. Creating a heavy chamfer allows for an overlapping excess of composite resin to flow over the two segments. This overlapping has been shown to accentuate the strength of the restoration [11,12].

Fig. 19. Final retracted view of the reattached coronal segment.

Fig. 20. Final full-face view of the reattached coronal segment.

Case report 3

Examination and background

An 11-year-old boy was injured during an athletic event and presented to the office with a fracture to the incisal one half of tooth 9 (Fig. 23). The medical history was noncontributory, periodontal status within normal limits for the patient's age, and there was no radiographic evidence of bony or hard tissue damage other than the fractured incisor. The tooth was asymptomatic and had no pulpal exposure; the tooth fragment was not recovered at the site of the incident. The chief concern expressed by the parents and the child during the examination and consultation was to be as conservative as possible with the treatment. The significant amount of tooth structure

Fig. 21. Eighteen month follow-up retracted view.

Fig. 22. Eighteen month follow-up full-face view.

missing posed a challenge for restorative options, mainly due to the patient's age, dental and tissue maturity, and unknown future pulpal health. These factors precluded the consideration of a full-coverage crown and led to a solution of using direct composite resins based on past experience and the considerable progress made in recent years with the aesthetics and physical properties of these materials [13–17].

Technique

The patient was anesthetized (0.9 mL 2% mepivacaine hydrochloride with 1:20,000 levonordefrin) and the remaining coronal portion of tooth 8 was prepared using a course-grit crown and bridge diamond bur (Brasseler

Fig. 23. Preoperative retracted view of the coronal fracture of tooth 8.

Fig. 24. A 360° bevel preparation was completed on the clinical crown and nonparallel grooves also were cut into the tooth for additional retention.

USA) to create a 360° chamfer around the parameter of the tooth. In addition, nonparallel grooves were cut into the labial and lingual aspects of the tooth to provide additional retention and resistance form for the composite restoration (Figs. 24 and 25).

A clear Mylar matrix band system (Contour Strip) was manipulated according to the manufacturer's directions and placed on the lingual portion of the prepared tooth and slid under the free gingival margin (Fig. 26). It was secured to the adjacent dry teeth and gingival tissues using an unfilled bond resin (Heliobond) that was subsequently cured with a visible light for 10 seconds. This process created a matrix-formed mold gingivally and interproximally in which to complete the composite restoration. There are several advantages related to the unique properties of the Contour Strip matrix [18–21]. First, the matrix creates a sealed system for the dentist that is free of saliva, crevicular fluids, and hemorrhage. The operator can work in a clean, dry environment and obtain a superior seal with the dentin bonding agent. Second, the ability to syringe the composite into this mold saves time and increases the efficiency for shaping the restoration because the

Fig. 25. Incisal view of prepared tooth.

Fig. 26. The Contour Strip was placed on the lingual aspect of the prepared tooth and secured with Heliobond to create a matrix-formed mold.

Contour Strip, when properly placed, helps to establish the contour of the final restoration. Finally, the highly polished Mylar surface transfers to the composite a level of surface polish unattainable by any current finishing system. Many studies evaluating polishing systems such as burs, diamonds, and disks, use the finish that the Mylar material transfers to the cured composite as a standard to which the finishing capability of the polishing system is measured [22–26].

The preparation was cleansed with 5% sodium hypochlorite applied with a disposable brush, rinsed with water for 10 seconds, and lightly air-dried. A total etch technique was employed using a 30+% acid etchant for 15 seconds (Fig. 27). The preparation was rinsed with a water spray for 15 seconds and gently air-dried. A single-component dentin bonding agent (Prime & Bond NT) was used according to the manufacturer's instructions and cured with a visible light source for 10 seconds (Fig. 28). A thin layer of a flowable composite (Heliomolar Flow [Ivoclar Vivadent, Inc.]) was applied with a brush, coating the entire preparation, and thinned with air. A body-shade composite (Heliomolar A2 [Ivoclar Vivadent, Inc.]) was syringed into the

Fig. 27. A "total etch" technique was employed using a 30+% acid etchant for 15 seconds and a fifth-generation dentin bonding agent.

Fig. 28. Incisal view of the preparation with the Contour Strip placed on the lingual aspect and secured with Heliobond.

matrix-formed molding, shaped with a flat-bladed instrument, and exposed to a visible light source for 20 seconds from the labial and lingual aspects of the tooth (Fig. 29). After curing, the Contour Strip and cured Heliobond collar were removed from the tooth using a scaler to reveal the highly polished surface as a result of the matrix band (Fig. 30).

Subsequently, a second Contour Strip matrix was placed from the facial aspect of the tooth and secured with Heliobond as previously described. Additional increments of composite were added using a cervical or body shade and an incisal shade (Heliomolar A2 and Filtek Supreme A1E) and contoured and blended with flat-bladed instruments and brushes before curing (Fig. 31). Final shaping and polishing were accomplished using the same protocol as previously mentioned to create a natural aesthetic result for the restoration (Fig. 32).

Discussion

This case illustrates the efficacy of direct composite resins as an aesthetic restorative tool. With the advent of improved materials, adhesive systems,

Fig. 29. After coating the preparation with a flowable resin, a traditional body composite was syringed into the matrix to form the lingual aspect of the resin restoration.

Fig. 30. The Contour Strip was removed to reveal the highly polished surface as a result of the matrix band.

Fig. 31. A second Contour Strip was placed on the labial aspect of the tooth in the same fashion, and the facial contours were completed with additional increments of body and incisal composites.

Fig. 32. Final retracted view of the polished 360° composite restoration.

unique matrices, and ancillary finishing and polishing systems, the ability to offer an aesthetic, conservative, and functional restoration is often an ideal choice for adolescent dental patients.

Case report 4

Examination and background

A 15-year-old boy was referred by his orthodontist for a consultation regarding the restoration of peg lateral incisors, teeth 7 and 10, and the associated postorthodontic space at the midline (Figs. 33–35). Records and radiographs were obtained from the orthodontist and an oral examination was completed. The patient's medical history was noncontributory, and there was no history of temporomandibular disorder symptoms. Periodontal status was within normal limits for the patient's age, and there was no radiographic evidence of hard tissue disease. The patient and his parents expressed a desire to create an aesthetically pleasing smile through as conservative a treatment as possible. The patient also wished to complete a course of nightguard vital bleaching of his dentition before any restorative work. Various treatment options were discussed with the patient and his family, including the use of direct composites and indirect porcelain veneers.

When evaluating a patient's dentition for an aesthetic change, various principles come into play in smile design, including the personal interpretations and desires of the patient and the dentist. Over the past few decades, the countless number of methods and techniques cited in the literature, taught in continuing education courses, and discussed in study clubs related to dental and facial harmony are far too voluminous to mention without failing to credit all those who have contributed to the knowledge base. Among the references available, probably none is more well known in smile design than "the golden proportion" [27,28]. This term has been referenced in nature since the time of Pythagoras; however, Lombardi [29] was the first to suggest that the patient as a whole be viewed when evaluating the smile to

Fig. 33. Retracted views of peg lateral incisors and midline diastema.

Fig. 34. Right lateral retracted view.

achieve facial harmony and the first to apply the terminology of the golden proportion to dentistry. Recently, Ward [30] introduced the concept of the ''recurring esthetic dental proportion.'' This concept states that the proportion of the successive widths of the teeth, when viewed from the frontal aspect, should remain constant as one moves distally and can be calculated using a mathematic equation. Relationships and guidelines such as these can serve as an excellent basis for evaluating a patient before enhancing his or her smile; however, adherence to particular formulas and ratios can often limit the creativity of the dentist and the patient when trying to meet the aesthetic goals of the case.

Various treatment options were discussed with the patient and the family, including the use of direct composites and indirect porcelain veneers. Probing of the periodontal tissues surrounding the crest of bone revealed excess gingival tissue around the two lateral incisors, and it was decided to recontour the gingival tissues around teeth 7 and 10 (after local anesthetic administration) to create a better tissue profile at the zeniths of the teeth (Fig. 36). Partial direct composite veneers were planned for the mesial-incisal aspects of teeth 8 and 9, full resin veneers for the undersized lateral incisors, and partial mesial veneers for the canines to balance the smile.

Fig. 35. Left lateral retracted view.

Fig. 36. Tooth 7 after gingival recontouring.

Technique

Conservative preparation of the enamel surfaces on tooth 8 was completed with a flame-shaped, fine-grit diamond bur using the technique previously described to create a distinct bevel on the labial and lingual surfaces of the tooth (Fig. 37). The Contour Strip matrix was placed, held tightly against the adjacent tooth across the diastema space with a flat-bladed instrument, secured with the Heliobond resin that was applied to the outside of the matrix onto the dried tissues, and light cured for 10 seconds. This process created a matrix-formed molding in which to complete the partial and full composite veneers (Fig. 38). The preparation was cleansed with 5% sodium hypochlorite on a disposable brush, rinsed with water, and air-dried. The acid etchant was applied beyond the preparation bevel for 15 seconds, removed with a stream of water for 15 seconds, and dried with a stream of air (Fig. 39). The use of a dentin bonding agent was not necessary in this case due to the conservative nature of the preparations being only in enamel.

A thin layer of flowable composite (Heliomolar Flow) was applied with a brush, pressed into the gingival and proximal areas, and thinned with

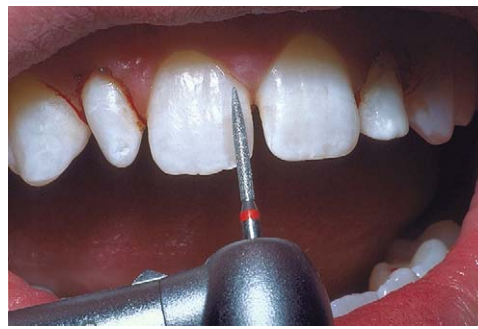

Fig. 37. Conservative enamel preparation on the labial and lingual surfaces to create a distinct bevel for the partial composite veneer.

Fig. 38. Contour Strip matrix was bonded into place with Heliobond that was applied on the outside of the band and the adjacent dried teeth and soft tissues, then cured with a visible light source.

Fig. 39. The beveled preparation was etched for 15 seconds, rinsed with water for 10 seconds, and air-dried. No dentin bonding agent was necessary because the preparation was entirely in enamel.

Fig. 40. A layer of flowable composite was applied to the etched enamel with a brush, air-thinned, then cured for 10 seconds.

Fig. 41. Three shades for composite were used to complete the partial veneer and were contoured with a flat-bladed Ash instrument.

a light stream of air. The flowable resin was not cured before the addition of the next layer of composite (Fig. 40). Next, a layer of traditional body composite was syringed into the matrix; the hydraulic action of the material forced the flowable resin ahead of the body composite, creating a void-free margin. Three shades of composite were used in this case: Heliomolar A1 (Ivoclar Vivadent, Inc.) as a gingival body shade, Tetric Ceram Shade Bleach Light (Ivoclar Vivadent, Inc.) for the middle third, and Vit-l-escence Trans Mist (Ultradent, South Jordan, Utah) for the incisal portion. The layers of composite were shaped and contoured with the Ash hand instrument and a ceramist brush before curing (Figs. 41 and 42).

After removal of the Contour Strip matrix, the composite restoration was shaped and polished with a fine diamond bur; 12-fluted, spiral-bladed carbide burs; and abrasive cups and disks (Figs. 43–45). The final views of the aesthetic results are shown in Figs. 46 through 48.

Discussion

The simplicity and value of employing direct composite resins cannot be overlooked in this particular case. Remaining postorthodontic spaces due to

Fig. 42. The composite is manipulated with a chisel-shaped ceramist brush.

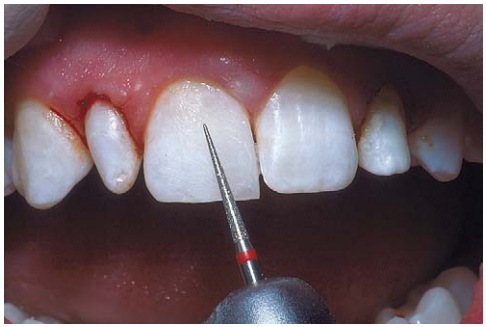

Fig. 43. The composite veneers were shaped and finished with fine diamond and 12-fluted, spiral-bladed carbide burs.

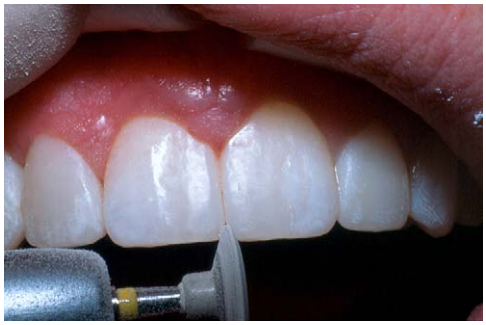

Fig. 44. Abrasive impregnated discs were used to refine embrassures.

Fig. 45. Final contouring and polishing was achieved with abrasive impregnated cups.

arch and tooth size discrepancies are a reality in many cases, and communication with the orthodontist as the case proceeds is imperative when there is a predetermined need for aesthetic care after active therapy. The use of various techniques to evaluate the smile before commencing treatment is

Fig. 46. Final right lateral retracted view of the finished composites at one week.

Fig. 47. Final left lateral retracted view of the finished composites at one week.

Fig. 48. Final retracted view of the full composite veneers on teeth 7 and 10 and the partial composite veneers on teeth 8 and 9 at one-week follow-up.

helpful to the dentist and must be considered along with optional restorative materials and techniques. Finally, the dentist's ability to creatively restore these areas in a conservative and aesthetically pleasing manner is not only a great service to the patient but also assists the orthodontist in a ''partnering'' fashion to complete the treatment.

Case report 5

Examination and background

A 17-year-old boy and his parents presented for the evaluation and restoration of an undersized lateral incisor, tooth 7, and a congenitally missing lateral incisor, tooth 10 (Fig. 49). The medical history was noncontributory to the case, but the patient reported a known allergy to bee stings. Periodontal health was within normal limits with no active dental caries, the occlusion was stable, and there was no evidence of temporomandibular disorder symptoms. Records and radiographs were obtained from the patient's previous dentist and orthodontist. The focus of the consultation appointment was to explore options such as dental implants and bonded bridges for the replacement of the missing lateral incisor.

The use of dental tooth implants has become a vital part of today's restorative armamentarium for a variety of reasons, and the materials and techniques used to place and restore them are constantly evolving. Certain parameters and guidelines, however, should be evaluated when considering the use of dental implants in the adolescent patient. Failure to properly assess these growth issues before placement could lead to a less than desirable result—functionally and aesthetically [1,31–33].

If a single tooth implant is placed while the patient is in a growing phase and the teeth are still erupting, then the implant may appear to be submerged below the plane of the adjacent teeth. This situation can result in gingival asymmetries between the implant crown and the adjacent clinical

Fig. 49. Preoperative retracted view of the undersized lateral incisor, tooth 7, and the congenitally missing lateral incisor, tooth 10.

crowns. Monitoring the growth stage of patients to establish whether they have stopped growing is a critical determinant in the viability of implant use. It has been suggested that serial cephalometric radiographs taken 6 to 12 months apart and preferably by the same technician on the same equipment be compared. If the tracings show that change has occurred, then the patient is still growing. Subsequent films may be taken at yearly intervals thereafter until no radiographic change in evident. At that point, the patient's growth is probably complete and implant placement can be considered. This film series should begin in girls around age 13 to 15 years and in boys at age 17 to 19 years when developmental growth is likely to be complete. The use of wrist films to monitor growth has been a reference source in the past, but there is uncertainty as to whether the results coincide with the completion of facial growth.

For cases in which the developmental growth of the patient is not complete or the patient or parents prefer not to explore the option of a dental tooth implant, alternative methods of treatment must be considered. The use of fiber reinforcement in dentistry has been a source of much research in direct and indirect application to splints, posts, and fixed prosthetics [34–42]. One particular technique (using polyethylene fibers to reinforce a direct composite bridge) is illustrated in this case. The definitive work on this type of direct bridge has been done by Belvedere [43], and numerous bridges of this type have been in function for over 10 years (unpublished data, 2003). A fiber-reinforced direct composite bridge can function as (1) a "transitional" restoration for those patients who must wait until their growth is complete to seek an implant procedure or (2) a potentially long-term aesthetic solution for those who desire a less invasive option to replace a missing anterior tooth. The fabrication of a fiber-reinforced direct composite bridge can offer the dentist the ultimate control in aesthetics because all of the steps are completed directly intraorally. The restoration in case 5 was completed using a modification of the Belvedere technique.

Technique

Several polyethylene fiber systems are available to the clinician for direct chairside application. Table 1 refers to some of the products currently in the marketplace. One of the key considerations in restoring a missing lateral incisor is the occlusion of the individual. Before beginning the procedure, the

Table 1
Currently available polyethylene fiber systems

Product	Company (location)	Fiber style
Connect	KerrLab Corporation (Orange, California)	Braided
DVA Fibers	Dental Ventures of America, Inc. (Corona, California)	Unidirectional
Ribbond	Ribbond (Seattle, Washington)	Woven
Splint-It	Jeneric/Pentron, Inc. (Wallingford, Connecticut)	Woven

Fig. 50. The gingival portion of the pontic button is shaped with a ceramist's brush directly on the clean, dry gingival ridge.

lingual occlusal contacts are marked with articulating ribbon to determine the areas of centric occlusion and protrusive and lateral excursive movements. Spacial considerations related to the depth and placement of the lingual preparations must be taken into account to create sufficient room for the fiber bundle.

The gingival or tissue-bearing side of the pontic (or pontic "button" as coined by Belvedere [43]) was created by taking a ball of unpolymerized composite similar in gingival shade to the adjacent teeth and fitted (modeled) directly onto the cleansed, dry tissue ridge. It was shaped with a ceramist brush to near ideal contours and cured for 20 seconds with a visible light source (Fig. 50). This represents the gingival half of the pontic. At this point, the pontic was removed from the space, polished on the tissue-bearing side only using abrasive rubber cups, and set aside.

Local anesthetic was administered (1.8 mL 2% mepivacaine hydrochloride with 1:20,000 levonordefrin). The lingual preparations were completed on each abutment tooth where the fibers were to be bonded in a cup-shaped fashion approximately 0.75 to 1 mm deep, depending on occlusal clearance, using a course, round-nosed diamond bur. When properly prepared, the

Fig. 51. Outline of preparations for the fiber-reinforced direct composite bridge as viewed from the lingual aspect.

Fig. 52. The pontic button was tried for fit after cutting the lingual slot in it.

lingual aspect for the bonding of the fibers should extend 1.5 mm from the incisal edge to a position 1 to 2 mm above the gingival tissues, and the diamond-cut finish line should extend around the proximal line angle of each abutment tooth (Fig. 51). A channel was cut with an inverted-cone diamond in the lingual aspect of the pontic button so that the fibers would be incorporated into the body of the pontic for resistance form, rather than just adhering to the lingual surface. The pontic was placed back into the space and evaluated for proper fit (Fig. 52).

The required length of fibers was determined by measuring the span from one prepared abutment to the other, ensuring that the fibers would be contained within the diamond-cut lingual preparations. The fiber bundle should eventually be allowed to "bow" into the slot cut in the button to become incorporated into the middle of the finished pontic. A piece of dental floss was used as a template and was recut to length until it met the requirements. The fibers were cut to length using a No. 15 scalpel blade and set aside (Fig. 53).

In preparation for the seating of the pontic button, all diamond-cut surfaces were cleansed with 5% sodium hypochlorite on a disposable brush, rinsed with water for 10 seconds, and lightly air-dried. The "total etch"

Fig. 53. The fiber bundle is cut with a scapel blade and evaluated for proper length before bonding into place.

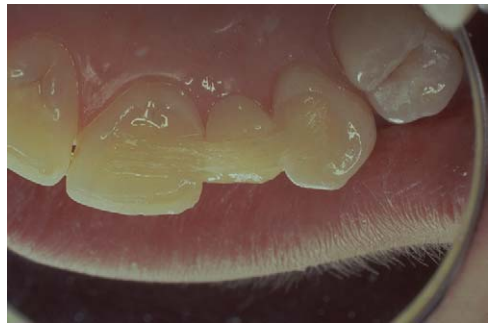

Fig. 54. After "tacking" the button into place with a flowable resin, the fiber bundle is coated with the same flowable composite and bonded into the lingual preparation trough.

technique was employed on the enamel and dentin areas of the preparations using a 30+% acid etchant for 15 seconds, rinsing with a water spray for 10 seconds, and lightly drying. This process was followed by a fifth-generation dentin bonding agent (Prime & Bond NT) applied according to the manufacturer's specifications. The dentin bonding agent was also applied to the proximal surfaces and lingual slot of the pontic button and was light cured. A small amount of a flowable resin (Heliomolar Flow) was syringed onto each of the proximal contacts, and the pontic was positioned back into place and exposed to a visible light source.

After the pontic was secured, an additional small amount of flowable composite was syringed into the lingual preparations and the pontic slot. Flowable composite was also applied to the fiber bundle and worked into the fibers by rubbing the resin into the bundle with gloved fingers, which thoroughly incorporated the flowable resin. The resin-rich bundle was seated into the lingual trough, pushed to place with a ball burnisher to seal all the fibers within the composite, and cured from the labial and lingual aspects for 40 seconds (Fig. 54).

Fig. 55. Subsequent layers of body and incisal shade composite are syringed onto the lingual aspect of the pontic.

Fig. 56. The incisal shade of composite is applied to the facial aspect to complete the composite bridge.

Fig. 57. Final retracted view. The incisal edges of teeth 8 and 9 were restored with composite resin, and a direct resin veneer placed on tooth 7 to compliment the aesthetics of the fiber-reinforced direct composite bridge replacing tooth 10.

The remaining portion of the fiber-reinforced bridge was created by syringing additional composite shades onto the lingual and facial surfaces and shaping with a brush to near final contour before curing for 40 seconds from the labial and lingual aspects of the tooth (Figs. 55 and 56). Occlusion was checked in centric, lateral, and protrusive movements. Final postcure finishing and polishing was achieved with 12-fluted, spiral-bladed carbide burs (Brasseler USA) and abrasive rubber cups and points (Ivoclar Vivadent, Inc.). The incisal edges of teeth 8 and 9 were restored with composite resin, and a direct resin veneer was fabricated on tooth 7 to compliment the shape of the fiber-reinforced direct composite bridge pontic. Fig. 57 shows the final retracted view of the completed case.

Discussion

The technology and resources available to dentists today offer a variety of solutions to many restorative challenges, and fiber-reinforced materials have a wide potential application to help meet these goals. The use of a fiber-

reinforced direct composite bridge offers an excellent solution for a missing anterior tooth as a ''transitional'' restoration until the patient reaches maturity or as a conservative, long-term prosthesis.

Summary

When considering the multitude of options available to dentists for aesthetic restorative treatment for adolescent patients, the use of conservative measures in treatment planning is always a prudent measure, especially in the consideration of adolescent patients. Creating a philosophy and a solution that is conservative, functional, and aesthetically pleasing and possesses good longevity should be the paramount goal. The use of direct composite resin restorations is an excellent tool that melds improved dental materials and technology with innovative delivery techniques to help solve these aesthetic dilemmas.

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