Fiber-Reinforced Bridge Replacement for Congenitally Missing Lateral Incisors

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In today's world, the dental professional is exposed to a myriad of complex esthetic, restorative, and functional challenges. There are also an equal number of dental procedures and materials available to accomplish treatment of these complex challenges. Many treatment alternatives are considered traditional or nontraditional. To the dental professional who is dedicated to providing state-of-the-art solutions to these complex situations, treatment outside what is considered "traditional" must sometimes be considered. Traditional treatment modalities may have proven track records, but at what cost to tooth conservation and esthetic outcomes? Many traditional modalities are also burdensome in time commitment and trauma to the patient.

Replacement of congenitally missing maxillary lateral incisors is one of the most challenging esthetic restorations. When presented with replacement of congenitally missing maxillary lateral incisors, the clinician must consider the choices available along with possible outcomes. Traditional treatment options include orthodontics, traditional 3-unit bridge, single tooth implant, or Maryland Bridge.

Orthodontic replacement of the lateral incisors with the cuspids, a traditional treatment option, is conservative, noninvasive, and has classically been used with great predictability. Such a treatment modality, however, requires a considerable time commitment and creates an esthetic end result that many would consider a failure. A traditional 3-unit bridge (porcelain-fused-to-metal or all-ceramic) is a viable solution. This treatment is predictable, but at the cost of excessive reduction of healthy tooth structure and, sometimes, compromised esthetics. A single tooth implant replacement could also be considered. Those who have chosen this option understand the commitment needed to achieve an esthetic outcome. Treatment with implants is invasive and it, too, requires a considerable time commitment of the patient. A Maryland Bridge is a conservative option, requiring minimal tooth structure removal, but strength, predictability, and esthetic outcome are questionable.

There is, however, a relatively new choice that uses new technology and materials. It is a conservative choice, and one with minimal tooth destruction or trauma to hard and soft tissues, minimal time commitment, and proven esthetic success. This option uses a fiber-reinforced wing retained framework and porcelain laminate veneers.

Case Study

A 12-year-old girl who had been a patient for 9 years was followed after congenitally missing maxillary lateral incisors Nos. 7 and 10 were identified. At age 12 the patient's parents presented their concern regarding their child's appearance. They were consulted on the need for treatment based on the poor positioning of the existing maxillary teeth and maxillary arch form collapse. The young patient was also showing signs of a class III malocclusion tendency. The parents were consulted on the need for orthodontic treatment to create a more ideal maxillary arch form, reduce the ensuing class III malocclusion, and reposition the maxillary anterior teeth to their proper eruption positions. All of this would become the "architectural blueprint"

***Figure 1**—Preoperative full face.*

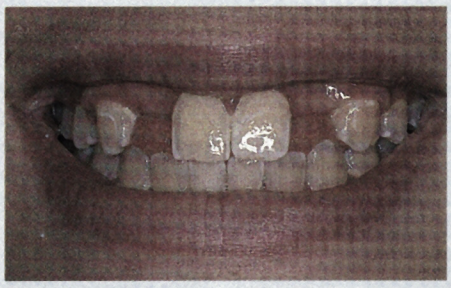

***Figure 2**—Preoperative full smile.*

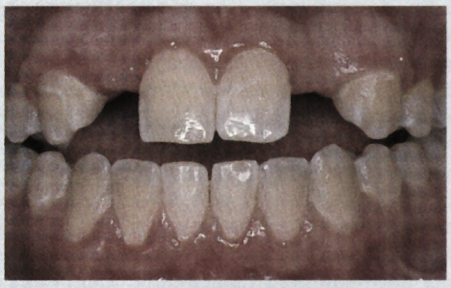

***Figure 3**—Preoperative/retracted view.*

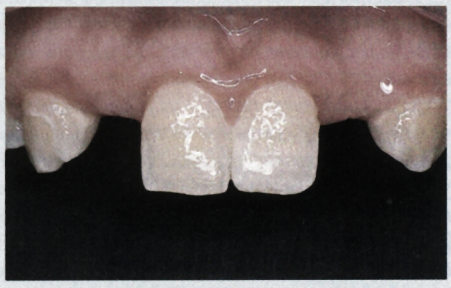

***Figure 4**—Preoperative retracted maxillary arch.*

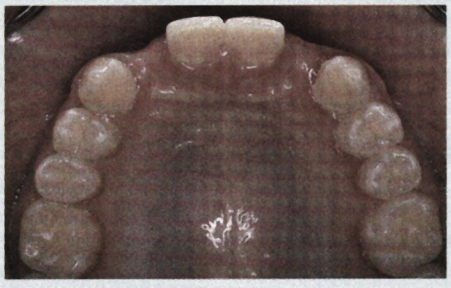

***Figure 5**—Preoperative maxillary arch.*

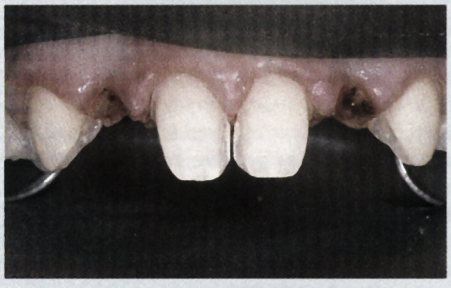

***Figure 6**—Final preparation: abutment and veneer.*

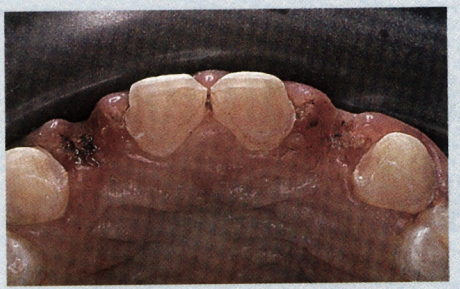

***Figure 7**—Final preparation: abutment, veneer, and ovate pontic sites.*

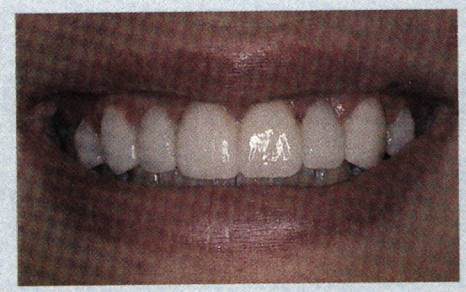

***Figure 8**—Provisional: full smile.*

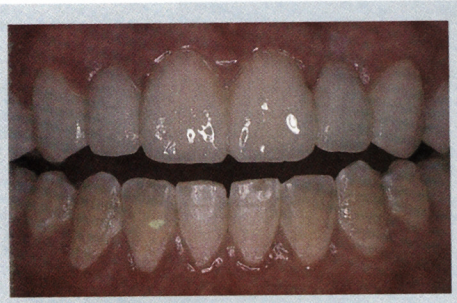

***Figure 9**—Provisional: retracted view.*

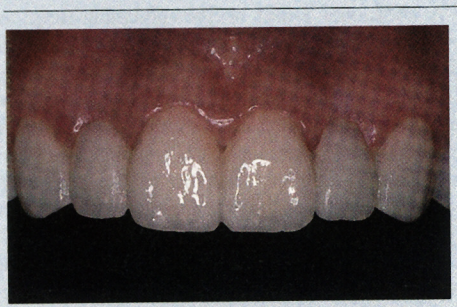

***Figure 10**—Provisional: retracted maxillary arch.*

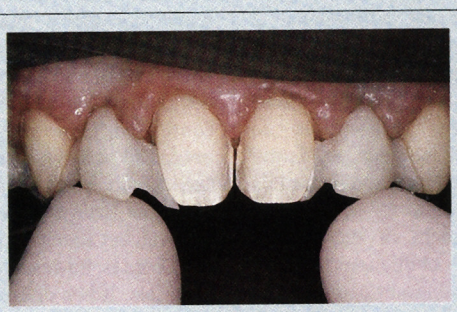

***Figure 11**—Try-in of fiber-reinforced framework on abutment teeth Nos. 6 through 11.*

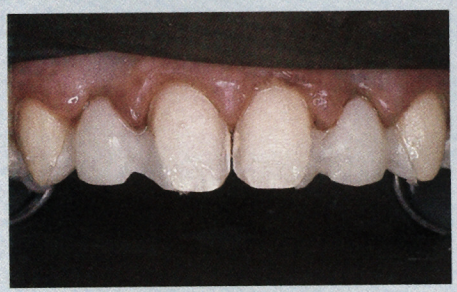

***Figure 12**—Fiber-reinforced framework luted in place on abutment teeth Nos. 6 through 11.*

for future restorative replacement of the missing teeth. The consultation included expectations of the orthodontic outcome and the future replacement of the missing teeth with a single tooth implant or fixed bridge.

Orthodontic treatment was initiated and completed in 24 months. A maxillary Hawley retainer was fabricated with lateral incisors in place. The patient was maintained in retention for an additional 12 months after orthodontic treatment.

At age 15, the patient and her parents again presented with their concerns regarding the finalization of dental treatment and the replacement of the missing teeth. The patient (Figures 1 through 5), now a young woman, had a growing concern about her appearance, and she found the maxillary Hawley retainer cumbersome. The patient was also self-conscious of tooth proportions and discoloration and expressed interest in a whiter, more attractive smile.

The patient and her parents were consulted on tooth replacement using a combination of porcelain laminate veneers with a composite resin fiber-reinforced framework.[1-5] This would restore the maxillary arch to function, replace the missing teeth, and improve the patient's smile. The advantages of this treatment option are conservative tooth preparation and exceptional esthetic results. The technique allows for the use of a low modulus material in the resin fiber-reinforced framework, as opposed to a high modulus material of metal or ceramic substructures. It is this lower modulus that allows less stress to the adhesive interface and some degree of flexibility to the restorative substructure.

Preoperative Examination

Upon approval to proceed with treatment, a comprehensive examination was performed. The patient presented with no active decay or restorations throughout both arches. Periodontal examination revealed generalized mild marginal and papillary gingivitis consistent with moderate attention to oral hygiene. The patient was consulted on the need for improved home care. Full mouth probing revealed periodontal pocket depths within normal limits. In the maxillary anterior quadrant, soft-tissue measurements were consistent with excess soft tissue particular to teeth Nos. 5, 6, 11, and 12, which could be recontoured to provide a more pleasing length-to-width ratio in the final restorations.

An updated full-mouth x-ray revealed no pathology. Occlusal examination revealed centric occlusion (CO) not equal to centric relation (CR) with occlusal interference in posterior quadrants resulting in a 1-mm to 1.5-mm slide from CR to CO. Two sets of diagnostic casts were made from alginate impressions. One set of casts was mounted by facebow transfer with a CR bite registration using bilateral manipulation[6] to a semi-adjustable articulator **(DENAR® Combi, Teledyne Water Pik Technologies, Inc.)**. Occlusal analysis and trial equilibration were performed on the models. The second set of casts was forwarded with a full set of diagnostic photographs to ceramist Adrian Jurim, of Jurim Dental Studios, for diagnostic wax-up.

Treatment Plan

After review of all diagnostic materials and consideration of all possible treatment options, the patient and her parents were consulted on the treatment recommendation of porcelain laminate veneers in conjunction with a composite resin fiber-reinforced framework to replace the missing teeth, Nos. 7 and 10. This treatment plan best met the objectives of providing a conservative, timely, atraumatic replacement of the missing teeth, as well as improving the patient's smile. The treatment plan would include an initial occlusal equilibration, and create balanced centric stops where CR would equal CO. Tooth whitening of the remaining dentition after veneer placement was also presented.

Diagnostic Wax-up

A detailed lab authorization was sent to the ceramist with diagnostic models and preoperative photos. A diagnostic wax-up was requested that would reflect the corrected length-to-width ratio of the anterior teeth. The wax-up would be used as a template for fabricating the provisional.

Preparation

The patient presented for the initial preparation appointment. Before anesthetizing the patient, an occlusal equilibration was performed to obtain even centric stops, eliminate posterior interference, eliminate the slide from CR to CO, and improve anterior guidance.

The patient was then anesthetized with 2% lidocaine 1:100,00 epinephrine. Before preparation, the sulcular depths and crestal bone position of the anterior teeth and pontic sites were probed. Tooth preparation was begun under 3.5x magnification **(Designs for Vision, Inc.)** with initial depth cuts placed on teeth Nos. 5 through 12, using the **Brasseler porcelain veneer kit (Brasseler USA)** bur #834-016, followed by facial and interproximal preparation with the #6844-014 bur. Approximately 0.5 mm of facial enamel was removed and a chamfer margin placed. The interproximal preparation on teeth Nos. 6, 8, 9, and 11

***Figure 13**—Postoperative full face.*

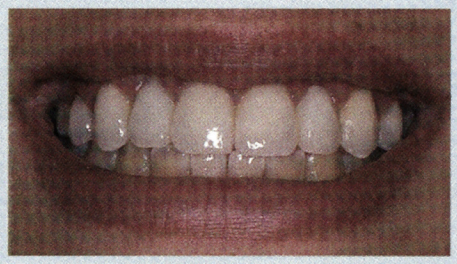

***Figure 14**—Postoperative full smile.*

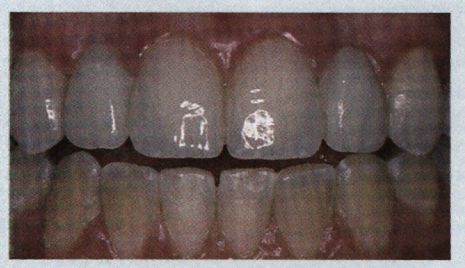

***Figure 15**—Postoperative retracted view.*

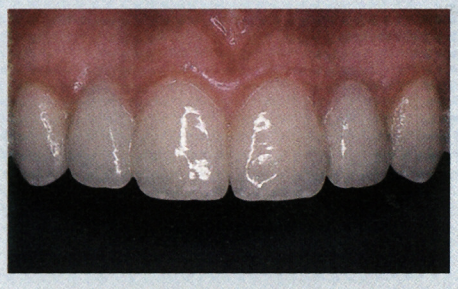

***Figure 16**—Postoperative retracted maxillary arch.*

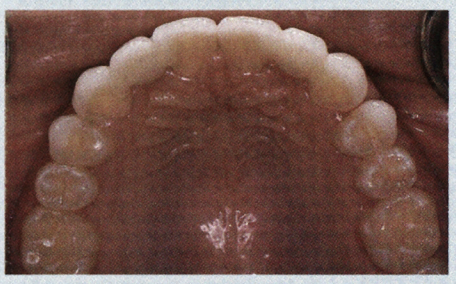

***Figure 17**—Postoperative maxillary arch.*

was extended straight through to the lingual. The contacts on teeth Nos. 5 and 12 were left intact. Appropriate extension of the preparation using the interproximal elbow technique carried the chamfer margin beyond the visible line angle for extension of porcelain.

Preparation of the abutment teeth was then initiated. Preparation of the interproximal connector design varies among clinicians, but the appropriate amount of reduction is required for material strength. The standard preparation[7,8] design was modified in this case to increase the interproximal connector size. Because of the patient's age, the design was altered to increase the strength of the material in this area in an attempt to provide a long-term stable result (Figures 6 and 7).

Without impinging upon the junctional epithelium and crestal bone, an electrosurgery unit **(Sensimatic TM 600SE, Parkell, Inc.)** was used to perform soft tissue recontouring around teeth Nos. 5, 6, 8, 9, 11, and 12 without involving the interproximal papillae. The buccal free gingival margin was modified to create esthetic contours to compliment the length-to-width ratio and position the gingival zenith. A 2.5-mm to 3.0-mm ovate pontic site was created in the positions of teeth Nos. 7 and 10 for creation of the ovate pontics. Final preparation of all tooth surfaces was completed, placing a final chamfer margin. All line angles were smoothed and rounded using a **Sof-Flex R Disc (3M)** at slow speed.

Impression

Full arch impressions were made in a stock **Spacer tray (GC America, Inc.)**. **Reprosil® (DENTSPLY®/Caulk)** medium impression material was flowed onto the teeth while Reprosil® heavy body impression material was loaded into the tray and seated to place. After 5 minutes the impression was removed and inspected for accuracy. An occlusal registration was made with **Simply Perfect™ (Discus Dental, Inc.).** An additional stick bite registration marking horizontal and vertical with relation to midline was made with Simply Perfect™, as well as a facebow transfer **(Denar® Corp., a div. of Teledyne Water Pik Technologies, Inc.)** registration of the maxillary arch tooth preparations.

Provisionals

Provisionalization (Figures 8 through 10) was achieved using a BIS-acrylic resin provisional material[9] **(Luxatemp, Zenith/DMG)** placed into a laboratory impression material matrix **(Sil-Tech® Putty, Ivoclar Williams)**, which replicated the diagnostic wax-up. Shade B1 was used because of the patient's desire to whiten her teeth substantially from their original shade. The tooth preparations were spot etched in the incisal one third with 37% phosphoric acid, and then rinsed and air-dried—not desiccated. An unfilled resin adhesive **(All-Bond®, Bisco, Inc.)** was very thinly coated over all aspects of the tooth preparation and light-cured. (The unfilled resin helps to secure the provisional in the etched zones, but also minimizes microleakage.)

The Sil-Tech® Putty matrix was loaded with the Luxatemp shade B1 BIS-acrylic resin, relative to the prepared teeth, and seated to place with constant firm pressure for 2.5 minutes to achieve a complete set. The matrix was then removed and the integrity of the provisional verified. All obvious loose flash was removed from the provisional/preparation interface. The provisionals were then completely trimmed and contoured to reflect the anticipated final porcelain laminate veneers. The provisionals were polished with **Enhance® cups (DENTSPLY®/Caulk)**, **FlexiCups™**, and **Enamalize™ (Cosmedent, Inc.)**. All surfaces were acid etched with 37% phosphoric acid and sealed with a 50/50 mix of **Luxaflow** composite **(Zenith)** and **Fortify™ (Bisco)** to achieve a high-gloss resistant surface. The occlusion was checked and excursive movements were verified before patient dismissal.

The patient returned to the office at the 1-week provisional evaluation appointment to re-evaluate the occlusion, esthetics, and phonetics, while not anesthetized. A full set of provisional photos was taken and a diagnostic provisional impression made. A detailed written prescription for a fiber-reinforced resin framework **(Sculpture®/FibreKor®, Jeneric®/Pentron®, Inc.)** and eight stacked porcelain laminate veneers—including initial diagnostic models, diagnostic wax-up, final impressions, bite registration, stick bite registration, facebow transfer jig, diagnostic models of the provisionals, stump shade guide, shade map, preoperative photos, and photos of the provisionals—was forwarded to the ceramist.

Shade

The prepared tooth stump shade **(Ivoclar Williams)** was recorded for future reference to aid the lab technician. The shade was chosen, after discussion with the patient, based on the shade of the provisionals. Since the patient was interested in whitening her teeth considerably, the decision was made to use B1 and OM1 with artistic characterization and surface texture, at the discretion of the clinician and the ceramist.

Cementation of Final Restorations

Upon their return from the ceramist, the fiber-reinforced framework and the veneers were inspected individually and for marginal fit on the master and solid models. At the insertion appointment, the patient was anesthetized and the provisional removed. The teeth were cleaned with a mixture of flour

of pumice and hydrogen peroxide, followed by rinsing and cleaning with 2% chlorhexidine solution, before being rinsed again. The framework (Figure 11) and veneers were then tried-in on the dry teeth to verify marginal fit. With the fit verified, a water-soluble try-in paste **(Insure™, Cosmedent, Inc.)** in a clear shade was used to try-in the framework and the veneers and evaluate shade and esthetics. With fit and esthetics satisfied, the frameworks and veneers were removed, washed, and internally cleansed with 37% phosphoric acid for 30 seconds to remove any surface contaminants. The framework and veneers were then washed, air-dried, primed with silane **(Ceramic Primer, 3M)** for 30 seconds, and air-dried again.

The prepared teeth were isolated using a split rubber dam technique, inspected, and cleansed again with pumice and 2% chlorhexidine solution, rinsed, air-dried, but not desiccated. The retainer preparation area of the abutment teeth was etched with 37% phosphoric acid for 15 seconds, rinsed, and gently air-dried. A dentin desensitizer **(Hurri-Seal®, Beautlich Pharmaceuticals)** was applied as a wetting agent and a cotton pellet used to blot dry the teeth and maintain moist dentin.[10] A single-component bonding agent **(Prime & Bond®N.T.™, DENTSPLY®/Caulk)** was applied in multiple coats with a scrubbing technique and allowed to penetrate the prepared areas for 20 seconds. The teeth were then gently air-dried with a moisture-free air source and cured with a plasma-arc curing light **(Apollo™ 95E, Dental/Medical Diagnostic Systems)** for 5 seconds.

The fiber-reinforced framework was internally coated with the bonding agent, though not light cured, and placed in a light secure box. A light-cured resin cement (Insure, shade clear) was loaded into a **Centrix syringe (Centrix, Inc.)** and dispensed onto the retainer preparation area of the abutment teeth. The frameworks were then placed and seated (Figures 11 and 12). Disposable bend-a-brushes and a rubber tip **(GUM, John O. Butler)** were used to brush off and surface clean excess resin cement from the facial, interproximal, and lingual surfaces. With all the excess cement removed, the frameworks were spot tacked in while seated under pressure for 1 second with the 3-mm tip and the Apollo 95E. The frameworks were then inspected, cleaned of any remaining cement, and cured to completion from the facial, lingual, and incisal surfaces. Any remaining cement was removed with a scaler.

The veneers were then treated, like the frameworks, with etchant, ceramic primer, and bonding agent. The prepared teeth were conditioned for bonding using the Total-Etch Wet Technique.[11,12] The veneers were then bonded using the rapid cementation technique, taught by Dr. Larry Rosenthal. The margins were coated with glycerin to prevent formation of the oxygen inhibited layer[13,14] and cured to completion from the facial, lingual, and the incisal. The rubber dam was removed and occlusion evaluated and adjusted for CR, lateral, and protrusive excursions. The interproximal surfaces and margins were then finished and polished using FlexiCups™, FlexiPoints™, and Enamalize™. The patient presented 1 week later for the final evaluation of the veneers, occlusion, and esthetics (Figures 13 through 17).

Conclusion

Replacement of congenitally missing maxillary lateral incisors can be an esthetic challenge that requires consideration of all possible methods of treatment. A conservative approach using a fiber-reinforced composite framework and porcelain laminate veneers is an excellent choice. The final restorations met the patient's esthetic requirements, and a more aggressive treatment option may be used as needed in the future.

Acknowledgments

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Product References

Product: All-Bond®, Fortify™
Manufacturer: Bisco, Inc.
Address: 1100 West Irving Park Rd. Schaumburg, IL 60193
Phone: 800/247-3368
Fax: 800/959-9550

Product: Apollo™ 95E
Manufacturer: Dental Medical Diagnostic Systems (DMD)
Address: 6416 Variel Ave. Woodland Hills, CA 91367
Phone: 800/399-0999
Fax: 818/595-0226

Product: Benda Brush®, Centrix syringe
Manufacturer: Centrix, Inc.
Address: 770 River Rd. Shelton, CT 06484
Phone: 800/235-5862
Fax: 888/CENTRIX

Product: Brasseler porcelain veneer kit
Manufacturer: Brasseler USA, Inc.
Address: One Brasseler Blvd. Savannah, GA 31419-9565
Phone: 800/841-4522
Fax: 912/927-8671

Product: Ceramic primer, Sof-Flex R Disc
Manufacturer: 3M Dental Products Division
Address: 2 E. 3rd Ave., Bldg 275 St. Paul, MN 55144-1000
Phone: 800/634-2249
Fax: 612/733-2481

Product: DENAR® Combi, facebow transfer
Manufacturer: Teledyne Water Pik Technologies, Inc.
Address: 1730 E. Prospect Ft. Collins, CO 80521
Phone: 800/525-2020
Fax: 800/289-4389

Product: Designs for Vision 3 x 5 magnifier
Manufacturer: Designs for Vision, Inc.
Address: 760 Koehler Avenue Ronkonkoma, NY 11779
Phone: 800/727-6407
Fax: 516/585-3404

Product: Enamalize™, FlexiCups™, Insure™
Manufacturer: Cosmedent, Inc.
Address: 5419 North Michigan Ave., Ste. 2500 Chicago, IL 60611
Phone: 800/621-6729
Fax: 312/989-1826

Product: Enhance® cups, Prime & Bond® NT ™, Reprosil®
Manufacturer: DENTSPLY®/Caulk
Address: 38 West Clarke Avenue Milford, DE 19963
Phone: 800/441-8448
Fax: 800/788-4110

Product: GUM
Manufacturer: John O. Butler
Address: 4635 W. Forest Ave Chicago, IL 60630
Phone: 800/528-8537
Fax: 800/553-2014

Product: HurriSeal®
Manufacturer: Beautlich Pharmaceuticals
Address: 1541 Shields Dr. Waukegan, IL 60085-8304
Phone: 800/238-8542
Fax: 847/473-1122

Product: Luxaflow, Luxatemp
Manufacturer: Zenith/Foremost
Address: 242 S. Dean St. Englewood, NJ 07631
Phone: 800/662-6383
Fax: 201/894-0213

Product: Sculpture®/FibreKor®
Manufacturer: Jeneric®/Pentron® Inc.
Address: PO Box 724 Wallingford, CT 06492
Phone: 800/551-0283
Fax: 877/677-8844

Product: Sensimatic® TM 600SE
Manufacturer: Parkell, Inc.
Address: 155 Schmitt Blvd., Box 376 Farmingdale, NY 11735-0376
Phone: 800/243-7446
Fax: 631/249-1242

Product: Sil-Tech Putty®
Manufacturer: Ivoclar Williams
Address: 175 Pineview Dr. Amherst, NY 14228
Phone: 800/533-6825
Fax: 716/691-2285

Product: Simply Perfect®
Manufacturer: Discus Dental, Inc.
Address: 8550 Higuera St. Culver City, CA 90232
Phone: 800/600-6748
Fax: 310/845-1537

Product: Spacer tray
Manufacturer: GC America
Address: 3737 W. 127th St. Alsip, IL 60803
Phone: 800/323-7063
Fax: 708/371-5103