Fiber-Reinforced Composites in Lingual Orthodontics

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The lingual technique is considered to be one of the most difficult, requiring extended treatment times and often achieving less-than-satisfactory results. First- and third-order tooth movements are complicated by the variable lingual tooth anatomy.[1] Torque control is also more problematic; with the reduced interbracket distance, even small variations in bracket height can have a substantial effect on torque. These factors have led to the development of various indirect bracket-positioning methods.[2]

Fig. 1 Self-ligating Philippe 2D lingual brackets.

A new, inexpensive, self-ligating bracket overcomes many of the drawbacks of lingual treatment while still providing high-quality results.[3,4] Instead of a rectangular slot, the Philippe 2D lingual bracket* has two wings on the lingual surface to contain the archwire (Fig. 1). Brackets are directly bonded to the lingual surfaces without an indirect setup. A progression of round nickel titanium archwires can be used to ensure

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Fig. 2 Case 1. 22-year-old female with central diastema before treatment.

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low force levels.

Glass fiber-reinforced composites (FRCs) have recently been introduced in dentistry for the fabrication of crowns, surface-retained bridges, root-canal restorations, and periodontal and orthodontic splints. The first published scientific studies and clinical reports have been encouraging.[5-12] In orthodontics, Burstone and Kuhlberg have recommended FRCs for both passive and active applications.[7] This article describes the use of FRCs as anchorage reinforcement in adult patients treated with the new bidimensional lingual appliances.

Case 1

A 22-year-old female came to our clinic for closure of a diastema between the maxillary central incisors (Fig. 2). She refused labial appliances, and was offered treatment with the 2D lingual brackets. These were bonded from first premolar to first premolar, and a power chain was

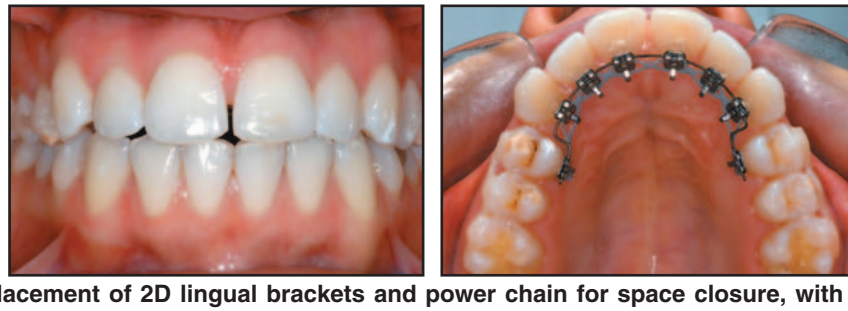

Fig. 3 Case 1. Placement of 2D lingual brackets and power chain for space closure, with FRC bars bonded from first premolar to first molar on labial side for anchorage.

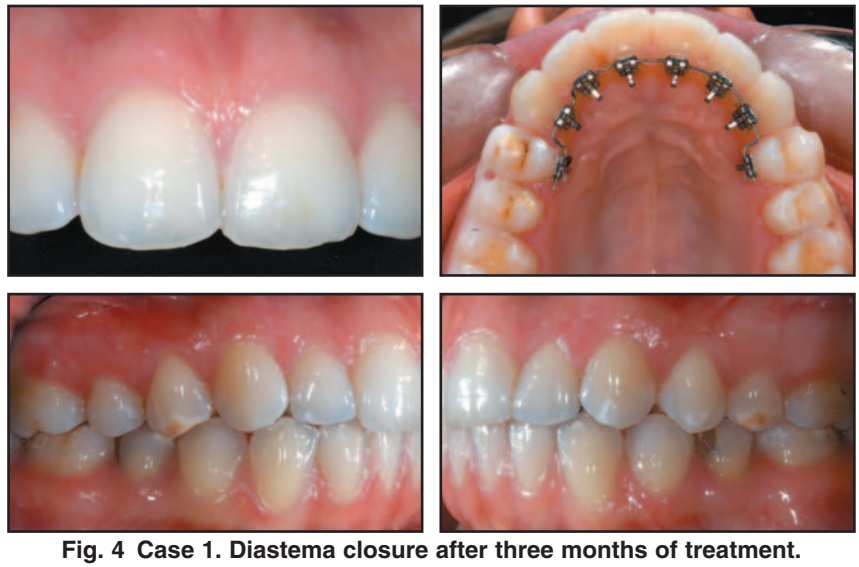

Fig. 4 Case 1. Diastema closure after three months of treatment.

attached to close the diastema (Fig. 3).

Two FRC bars (everStick Perio**) were bonded to the labial surfaces of the first and second premolars and first molars to form rigid anchorage units (Fig. 3). On each side, the exact length of the required FRC was measured, and the fiber was cut with scissors directly from the package. The buccal surfaces of the teeth were microetched for three seconds each, then etched with 37% phosphoric acid for 30 seconds each. The bonding agent was applied with a small brush, and the area was light-cured. Next, a thin layer of flow composite was applied to the enamel surfaces, and the FRC was positioned and pressed against the composite with hand instruments. Each tooth was light-cured for five seconds, the entire fiber bundle was covered with another layer of flow composite, and the entire area was light-cured for an additional 40 seconds.

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After three months of treatment, the anterior diastema was completely closed (Fig. 4).

Case 2

A 65-year-old woman was referred with general periodontitis, a severely compromised upper left canine, and an ectopic upper left lateral incisor (Fig. 5). The treatment plan involved periodontal therapy, followed by extraction of the maxillary left canine, movement of the ectopic lateral incisor into the canine position, and reshaping of the left first premolar as a canine.

After the canine extraction, two secure anchorage units were created in the buccal segments by connecting the teeth with everStick C&B.** A rigid stainless steel transpalatal bar was bonded directly to the lingual surfaces of the maxillary right canine and first molar, and a power arm was bonded to the lingual surface of the left lateral incisor (Fig. 6). To retract the incisor, a power chain was stretched from the

Fig. 5 Case 2. 65-year-old woman with general periodontitis, severely compromised maxillary left canine, and ectopic maxillary left lateral incisor before treatment.

power arm to a soldered hook on the transpalatal bar.

Once the incisor had been completely retracted, the bidimensional lingual brackets were bonded to the anterior teeth, and an .014" superelastic nickel titanium archwire was inserted to correct the inclination and rotation of the lateral incisor and finish the case (Fig. 7). Eight months

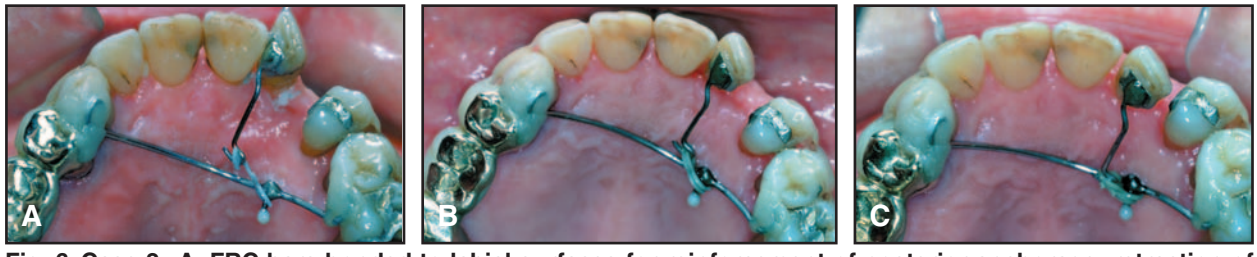

Fig. 6 Case 2. A. FRC bars bonded to labial surfaces for reinforcement of posterior anchorage; retraction of maxillary left lateral incisor with power chain stretched from bonded power arm to soldered hook on bonded transpalatal bar. B. After three months of treatment. C. After five months of treatment.

Fig. 7 Case 2. A. Placement of 2D lingual brackets and .014" superelastic nickel titanium archwire. B. Correction of lateral incisor inclination and rotation after eight months of fixed appliance treatment. C. Closure of residual space with power chain.

Fig. 8 Case 2. Patient after 14 months of orthodontic treatment, showing bonded FRC lingual retainer.

later, the lateral incisor was properly positioned, and the residual space was closed with power chain.

The entire orthodontic treatment lasted 14 months (Fig. 8). After bracket removal, an FRC retainer was bonded for indefinite retention.

Conclusion

This article shows how FRCs can substitute for traditional stainless steel labial anchorage in lingual orthodontics. With better bonding characteristics than metals, FRCs are able to connect a number of teeth into rigid units that can be used for passive or active purposes. The glass fibers are so transparent as to be virtually invisible.

Although lingual orthodontics demands special biomechanical expertise and technical skills, the new 2D brackets are a viable alternative to conventional lingual appliances in adult cases that do not require 3rd-order tooth movements.

REFERENCES

1. Nidoli, G.; Lazzati, M.; Macchi, A.; and Castoldi, A.: Analisi clinico-statistica della morfologia dentale in rapporto al posizionamento dei bracket linguali, Mondo Ortod. 10:45-53, 1985.
2. Alexander, C.M.; Alexander, R.G.; Gorman, J.C.; Hilgers, J.J.; Kurz, C.; Scholz, R.P.; and Smith, J.R.: Lingual orthodontics: A status report, J. Clin. Orthod. 16:255-262, 1982.
3. Macchi, A.; Tagliabue, A.; Levrini, L.; and Trezzi, G.: Philippe self-ligating lingual brackets, J. Clin. Orthod. 36:42-45, 2002.
4. Macchi, A.; Norcini, A.; Cacciafesta, V.; and Dolci, F.: The use of bidimensional brackets in lingual orthodontics: New horizons in the treatment of adult patients, Orthod. 2004 1:21-32, 2004.
5. Bae, J.M.; Kim, K.N.; Hattori, M.; Hasegawa, K.; Yoshinari, M.; Kawada, E.; and Oda, Y.: The flexural properties of fiber-reinforced composite with light-polymerized polymer matrix, Int. J. Prosthod. 14:33-39, 2001.
6. Behr, M.; Rosentritt, M.; Ledwinsky, E.; and Handel, G.: Fracture resistance and marginal adaptation of conventionally cemented fiber-reinforced composite three-unit FPDs, Int. J. Prosthod. 15:467-472, 2002.
7. Burstone, C.J. and Kuhlberg, A.J.: Fiber-reinforced composites in orthodontics, J. Clin. Orthod. 34:271-279, 2000.
8. Freudenthaler, J.W.; Tischler, G.K.; and Burstone, C.J.: Bond strength of fiber-reinforced composite bars for orthodontic attachment, Am. J. Orthod. 120:648-653, 2001.
9. Narva, K.K.; Vallittu, P.K.; Helenius, H.; and Yli-Urpo, A.: Clinical survey of acrylic resin removable denture repairs with glass-fiber reinforcement, Int. J. Prosthod. 14:219-224, 2001.
10. Sewon, L.A.; Ampula, L.; and Vallittu, P.K.: Rehabilitation of a periodontal patient with rapidly progressing marginal alveolar bone loss: 1-year follow-up, J. Clin. Periodontol. 27:615-619, 2000.
11. Vallittu, P.K. and Sevelius, C.: Resin-bonded, glass fiber-reinforced composite fixed partial dentures: A clinical study, J. Prosth. Dent. 84:413-418, 2000.
12. Vallittu, P.K.: Case report: A glass fibre reinforced composite resin bonded fixed partial denture, Eur. J. Prosthod. Restor. Dent. 9:35-39, 2001.