Four applications of reinforced polyethylene fiber material in orthodontic practice

Ali Ihya Karaman, DDS, PhD,[a] Nihal Kir, DDS,[b] and Sema Belli, DDS, PhD[c]
Konya, Turkey

Four different orthodontic applications of a polyethylene fiber material are shown and discussed in case reports. Ribbond (Ribbond Inc, Seattle, Wash), a bondable, reinforced polyethylene fiber material, was successfully used in a fixed orthodontic retainer, a space maintainer, a temporary postorthodontic fixation device to attach a pontic to abutment teeth during periodontal therapy, and a posttraumatic stabilization splint. This clinical practice was based on earlier studies showing that the polyethylene fiber material adapted easily to dental contours and could be manipulated during the bonding process. It also has acceptable strength because of good integration of fibers with composite resin; this leads to good clinical longevity. Because thinner composite resins can be used, the volume of the splint can be minimized. There is no need for significant tooth structure removal, so the technique is reversible and conservative. It also satisfies patients' esthetic expectations. These cases show that Ribbond is a promising splint material for use in orthodontic practice. (Am J Orthod Dentofacial Orthop 2002;121:650-4)

Various composite resins are used in orthodontic treatment to bond brackets and splint teeth. In a splint, wires, pins, and mesh grids are mechanically locked with a composite resin without any chemical interaction. Over time, stresses can occur at the interface between these materials and the composite resins that can lead to failure. Clinical failures are usually due to insufficient composite, which leads to breakage, or overbulked composite, which can cause plaque retention and gingival inflammation. Recently, composite reinforcement fibers that are bondable, biocompatible, esthetic, and easily manipulated have been introduced.

Ribbond (Ribbond Inc, Seattle, Wash) is a reinforced ribbon made of ultrahigh molecular weight polyethylene fiber that has an ultrahigh modulus (Fig 1). It is treated with cold gas plasma to enhance its adhesion to synthetic restorative materials, including chemically cured or light-cured composite resins. The special fiber network of this material allows efficient transfer of forces acting on itself. It is virtually pliable and thus adapts easily to the tooth morphology and dental arch contours. Its translucency makes it an excellent esthetic material, and it can be cured with light-cured composites. It is used in periodontal splinting,[1] directly bonded endodontic posts and cores,[2,3] conservative treatment of cracked tooth syndrome,[4] the creation of a fixed partial denture with a composite resin pontic or a natural tooth pontic,[5,6] trauma stabilization,[7] orthodontic fixed lingual retainers,[8,9] and space maintainers.[10] In this report, we present 4 applications of Ribbond in orthodontic practice.

From the Faculty of Dentistry, Selçuk University, Konya, Turkey.
[a]Associate professor, Department of Orthodontics.
[b]Postgraduate student, Department of Orthodontics.
[c]Associate professor and chair, Department of Endodontics.
Reprint requests to: Dr Sema Belli, Selçuk University, Faculty of Dentistry, Department of Endodontics, 42079 Campus, Konya Turkey; e-mail, sbelli@selcuk.edu.tr.
Submitted, November 2001; revised and accepted, January 2002.

0889-5406/2002/$35.00 + 0 **8/1/123818**
doi:10.1067/mod.2002.123818

Fixed orthodontic retention appliance

The retention protocol for a 16-year-old patient included a fixed lingual retainer. For this purpose, the dental arch length between 33 and 43 (FDI tooth numbers) was measured, and the lingual surfaces of the teeth were cleaned with pumice, acid etched with 36% orthophosphoric acid (Scotchbond Etchant, 3M Dental Products, St Paul, Minn) for 30 seconds, washed, and dried. The required length of Ribbond was cut (with a special scissors supplied by the manufacturer to prevent unraveling) and then saturated with a few drops of bonding agent (Transbond XT Light-cure Adhesive Primer, 3M Unitek, Monrovia, Calif). (The saturated Ribbond was protected from exposure to light to prevent polymerization.) A flowable composite (Protect Liner F, Kuraray Co, Ltd, Tokyo, Japan) was applied to the enamel surfaces, and the Ribbond was placed. Slight pressure was applied with a rounded instrument to create close contact during the curing process. The fibers were coated with a light-cured composite (Transbond XT Light-Cure Adhesive Paste, 3M Unitek) (Fig

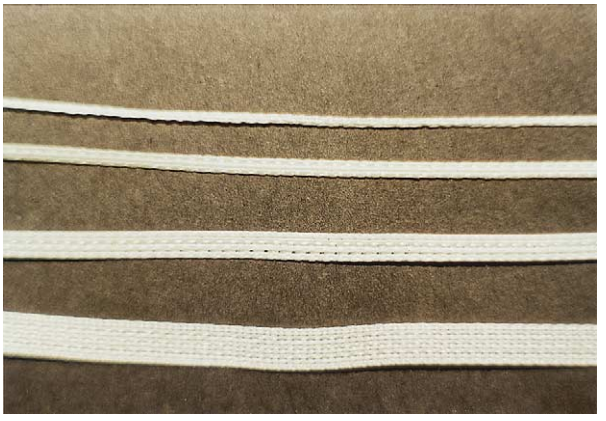
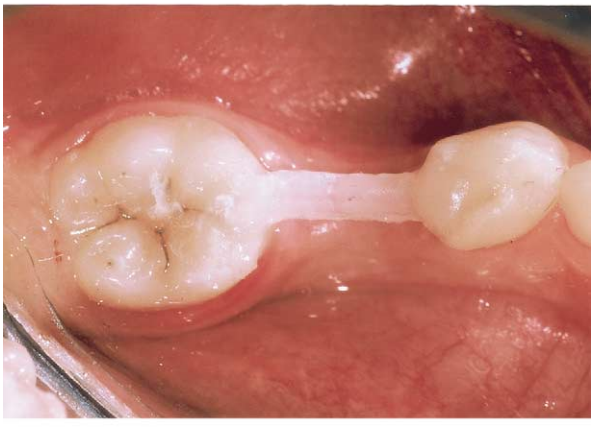


Fig 1. Bondable reinforcement ribbon in 4 sizes.

Fig 2. Ribbond polyethylene fiber coated with light-cured composite, used for fixed orthodontic retention.

a.



b.

Fig 3. Ribbond used as fixed space maintainer. **A,** Placement of polyethylene fiber material; **B**, occlusal view of finished space maintainer.

2), the embrasures were shaped to facilitate good oral hygiene, and the composite was polished.

Fixed space maintainer

A space maintainer was needed between tooth numbers 74 and 36 after tooth 75 was extracted because of caries in a 9-year-old patient. Polyethylene fiber material was used in the space maintainer. Because the dentin borders were reached during removal of caries on the distal surface of tooth 74, a dentin primer (Prime & Bond NT, Dentsply International, Inc, York, Pa) was used initially. Then a Ribbond segment, saturated as described above, was bonded with flowable composite and covered with a light-cured composite (Fig 3).

Temporary esthetic retention appliance

A 21-year-old female patient with advanced periodontitis was treated with fixed orthodontic appliances to resolve anterior crowding. A temporary esthetic retention appliance was needed for postorthodontic retention and periodontal healing. An acrylic tooth would replace the missing right central incisor, and a 33-43 fixed retention appliance would be placed. First, pontic-bearing space was prepared between tooth numbers 12 and 21 with 3 Ribbond segments (Fig 4, *A*). The acrylic tooth was then bonded with light-cured composite so as not to interfere with anterior and lateral jaw movements (Fig 4, *B*). This temporary solution was esthetic, functional, and simple (Fig 4, *C*).

Posttraumatic stabilization splint

An 11-year-old boy presented with an acute alveolar fracture in his incisor region; his diagnosis was luxation of the right central incisor in the vestibulopalatal direction (Fig 5, *A*). We decided to splint the teeth

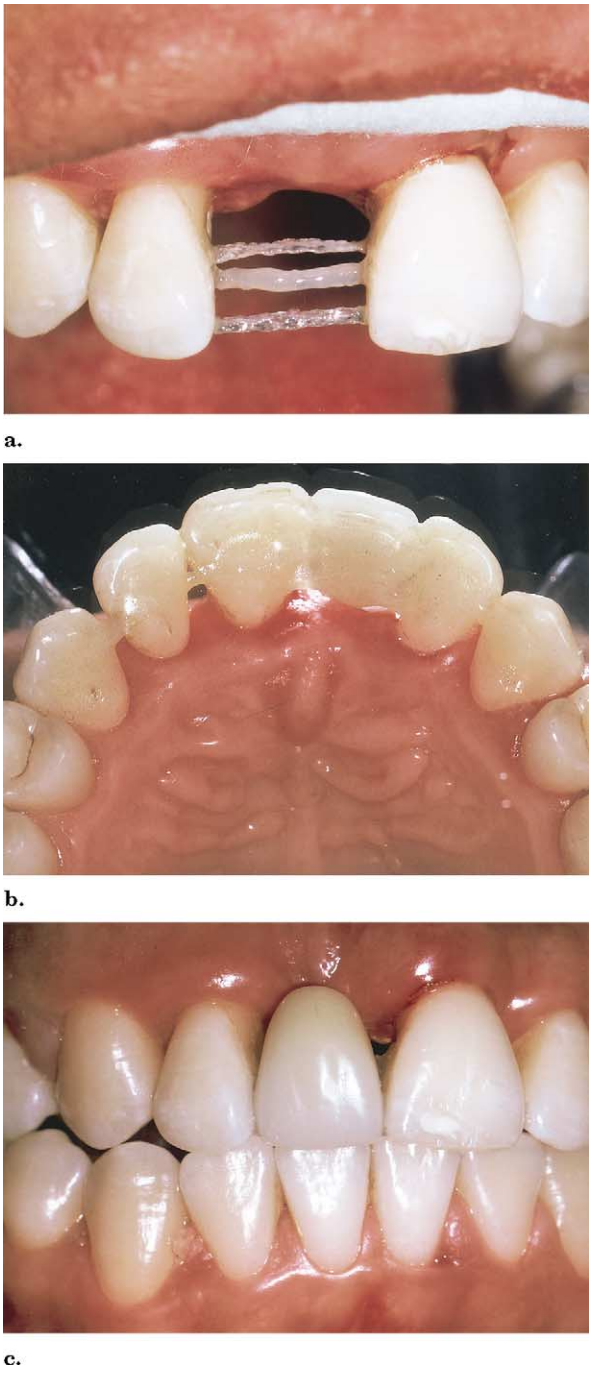


Fig 4. Ribbond used as temporary esthetic retention appliance. **A**, Pontic space prepared with 3 separate Ribbond segments; **B**, palatal view of temporary appliance with acrylic tooth in place; **C**, frontal view.

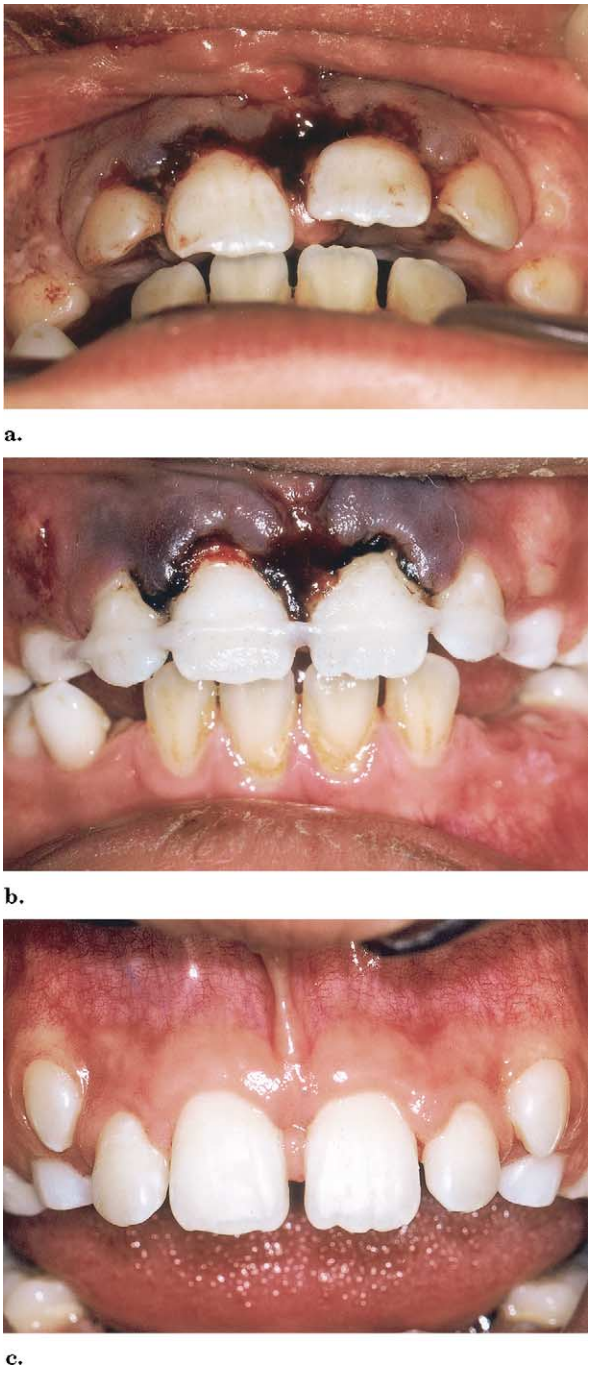


Fig 5. Ribbond used in posttraumatic stabilization splint. **A**, Traumatized anterior segment; **B**, teeth stabilized with polyethylene fiber material; **C**, frontal view after healing.

between 13 and 23 to stabilize them and the alveolar segment. The labial surfaces of the teeth were bonded with a 2-mm wide Ribbond ribbon (Fig 5, *B*). During light-curing of the ribbon, the palatally displaced central tooth, which was returned to its original position by using a hand instrument, was added to the splint. Approximately 40 days later, the fractured region and the teeth appeared stable. After the healing period, the

Ribbond was removed with a tungsten carbide bur, which can be used with a micromotor (Fig 5, *C*).

DISCUSSION

Splinting teeth for periodontal, orthodontic, or posttraumatic reasons is a common procedure. Although traditional methods are successful, splinting teeth with reinforcement fibers that can be embedded in composites has gained popularity. Ribbond is a biocompatible, esthetic material made from a high-strength polyethylene fiber. The various advantages of this material include ease of adaptation to dental contours and ease of manipulation during the bonding process. Because it is a relatively easy and fast technique (no laboratory work is need), procedures can often be completed in a single appointment. It also has acceptable strength because of good integration of fibers with the composite resin; this leads to good clinical longevity. Because a thinner composite resin is used, the volume of the retention appliance can be minimized. In addition, in case of fracture during wear, the appliance can be easily repaired. There is no need for removal of significant tooth structure, making the technique reversible and conservative. It also meets the patients' esthetic expectations.

In this report, 4 different orthodontic applications of Ribbond are presented. Strassler et al[9] reported on the use of polyethylene fiber for postorthodontic stabilization and retention, tooth replacement, and periodontal splinting. They splinted 64 teeth in 30 patients using Ribbond. Clinical results were based on 12 to 48 months of evaluation. All periodontal splints and fixed orthodontic retention with Ribbond were successful, and none exhibited debonding or recurrent caries. In 2 patients in whom maxillary retention was applied, ribbon fibers were exposed because of the occlusal function; hence, these regions were covered with flowable composite. Only 1 of 9 natural tooth or composite resin pontics was fractured during the study, and, although the fracture of composite resin was apparent, the pontic did not separate from the abutment tooth because the Ribbond held it in place. The crack was repaired by using an adhesive enamel/composite resin technique. In all cases, the color of the teeth or the composite resin was not affected by the Ribbond.

Strassler et al[9] suggested using Ribbond as a orthodontic retainer, and Bearn[11] stated that reinforcement fibers have the disadvantage of a rigid splint, which limits physiologic tooth movement and contributes to a higher clinical failure rate. We also found that this material made a rigid splint and suggest that long-term clinical studies on a larger sample are needed.

It is sometimes advisable to prepare a lingual groove intercoronally to reduce the splint thickness when Ribbond is used as a periodontal splint (because of tooth rotation and misalignment) or for temporary partial fixed prosthesis fabrication; thus, the finished splint will be less bulky and will wear better in the long run. Acceptable strength could be obtained with a thin splint without the need for that kind of preparation in our orthodontic retainer patients because the teeth were aligned.

For the patient who needed a temporary esthetic retention appliance, we selected a preformed acrylic pontic, similar in shape to the missing tooth, as suggested by Meiers and Freilich.[6] This is thought to be more practical than the indirectly prepared composite resin pontic technique.

Conventional surface preparation procedures call for sandblasting the teeth with a microetcher and roughening the enamel with small tapered diamonds before etching. These methods can cause tissue abrasion if a rubber dam is not used. We found that clinically acceptable strength can be obtained by cleaning the teeth with nonfluoridated pumice or paste.

Occasionally, the composite resin portion of a splint fractures, and the exposed fibers can cause plaque to accumulate. The fibers must be coated with flowable composite to prevent this. Embrasures must be shaped and finished adequately to permit good oral hygiene.

The present study indicated that polyethylene fibers can be used not only for prosthodontic and periodontal purposes, but also for orthodontic reasons. Today, the applications for composite reinforcement fibers seem very promising in splinting and stabilizing teeth. The results of this report agree with previous studies. However, the prolonged use of this material for retention in orthodontic patients must be evaluated with long-term studies.

REFERENCES

1. Strassler HE, Serio FG. Stabilization of the natural dentition in periodontal cases using adhesive restorative materials. Periodontal Insights 1997;4:4-10.
2. Hambrook DS, Hastings JH. Use of bondable reinforcement fiber for post and core build-up in an endodontically treated tooth: maximizing strength and aesthetics. Prac Periodont Aesthet Dent 1995;7:33-44.
3. Kama JC. A fiber composite laminate endodontic post and core. Am J Dent 1996;9:230-2.
4. Kama JC. Conservative treatment of cracked tooth syndrome using Ribbond fiber-reinforced composite resin. Dental Products Report, September 2000. p. 48-9.
5. Belli S, Özer F. A simple method for single anterior tooth replacement. J Adhesive Dent 2000;2:67-70.

6. Meiers JC, Freilich MA. Chairside prefabricated fiber-reinforced resin composite fixed partial dentures. Quintessence Int 2001;32: 99-104.
7. Strassler HE. Aesthetic management of traumatized anterior teeth. Dent Clin North Am 1995;39:353-66.
8. Miller TE. A new material for periodontal splinting and orthodontic retention. Compend Cont Edu 1993;14:800-12.
9. Strassler HE, Scherer W, LoPresti J, Rudo D. Long term clinical evaluation of a woven polyethylene ribbon used for tooth stabilization and splinting. J Israel Orthod Soc 1997;7:11-5.
10. Portilla M. How to construct a new type of anterior deciduous bridge. J Southeastern Soc Pediatr Dent 3 Quarter;2:14-6.
11. Bearn DR. Bonded orthodontic retainers: a review. Am J Orthod Dentofacial Orthop 1995;108:207-13.