Use of Polyethylene Fiber (Ribbond) in Pediatric Dentistry

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Abstract

Polyethylene fiber (Ribbond) is a bondable, biocompatible, esthetic, translucent material. By virtue of its wide spectrum of intended properties, it enjoys various applications in clinical dentistry. Different clinical applications of Ribbond include space maintainers, fixed partial dentures with a natural tooth pontic, endodontic posts and cores and splint materials in children. Ribbond can be used as an alternative to conventional treatment in pediatric dentistry.

Keywords: Ribbond, pediatric dentistry

Introduction

Fiber-reinforced composites (FRC) are resin-based materials containing fibers aimed at enhancing their physical properties. These were first introduced in the 1960s by Smith when glass fibers were used to reinforce polymethylmethacrylates [1]. The development of the fiber-reinforced composite technology has brought a new material into the realm of metal-free adhesive esthetic dentistry [2]. Different fiber types such as glass fibers, carbon fibers, Kevlar fibers, Vectran fibers, and polyethylene fibers have been added to composite materials [3]. Glass fibers, consisting of glass interlaced filaments, improve the impact strength of composite materials. They have excellent esthetic properties, but they do not easily stick to the resinous matrix [4]. Carbon fibers prevent fatigue fracture and strengthen composite materials, but they have a dark color that is esthetically undesirable [3,5,6]. Kevlar fibers, made of an aromatic polyamide, increase the impact strength of composites, but they are unaesthetic, hence their use is limited [7]. Vectran fibers are synthetic fibers made of aromatic polyesters. They show a good resistance to abrasion and impact strength, but they are expensive and not easily wielded [3]. However, polyethylene fibers improve the impact strength, modulus of elasticity and flexural strength of composite materials. When compared to other fibers, they are almost invisible in the resinous matrix. Due to these reasons, they are the most appropriate and the best esthetic strengtheners of composite materials [3]. The use of this fiber is based on the clinical reports of tooth replacement by Bradenstein and Sperber, Marcus, and Millerand Portilla, among others [8]. This fiber has been described as being used for perio splints,
strengthening removable prosthesis, prosthesis, post and core fabrication, and provisional use.

**Ribbond**

Ribbond fibers, introduced to the market in 1992, are bondable reinforced fibers consisting of ultrahigh-strength polyethylene fibers. These fibers far exceed the breaking point of fiberglass and are so tough that specially made scissors are required to cut them. Unlike Kevlar, Ribbond’s fibers absorb less moisture than the dental resins [9].

The key to Ribbond’s success (and what distinguishes Ribbond from the other fiber reinforcements) is its patented leno weave. Designed with a lock-stitch feature that effectively transfers forces throughout the weave without stress transfer back into the resin, Ribbond’s weave also provides excellent manageability characteristics. Having virtually no memory, Ribbond adapts to the contours of the teeth and dental arch [9].

Ribbond bonds to any composite system. You choose the composite Magnified 110,000 times; SEMs demonstrate complete incorporation of the resin to Ribbond’s fibers (note a lack of voids). Forces within the resin are easily transferred to the fibers, ensuring that the Ribbond is an integral strength member of the prostheses [9]. Ribbond fibers easily absorb water because of the “gas-plasma” treatment to which they are exposed. This treatment reduces the fibers’ superficial tension, ensuring a good chemical bond to composite materials. Ribbond is biocompatible, esthetic, translucent, practically colorless and disappears within the composite or acrylic without show-through [3,9,10]. Ribbond fibers are also characterized by impact strength five times higher than that of iron [3]. Despite this versatility, there are few reports on the use of Ribbond in pediatric dentistry [11].

**Applications in Pediatric Dentistry**

**Endodontic post and core**

Despite the fact that it is largely preventable, dental caries is the most common chronic disease in childhood [12]. Caries in very young children, known as early childhood caries, may be defined as at least one carious lesion affecting a maxillary anterior tooth in a preschool-age child [13]. With the introduction of fluorides, though the caries prevalence has decreased substantially, children still continue to present these problems. The caries may take a toll and may result in total destruction of the dental elements in cases like early childhood caries. The oral rehabilitation of these teeth is a great challenge for pediatric dentistry [14]. Until very recently, the only treatment option for early childhood caries was extraction of the affected primary anterior tooth, which resulted in severe coronal destruction [15]. The early loss of primary anterior teeth may result in reduced masticatory efficiency, loss of vertical dimension, development of parafunctional habits (tongue thrusting, speech problems), esthetic functional problems such as malocclusion and space loss, and psychological problems that can interfere in the personality and behavioral development of the child [16,17]. Various restorative treatment options are pre-fabricated crown and biological and resin composite restoration either by means of direct or indirect techniques mentioned in the literature. Reinforcement fibers (polyethylene fibers) were recently introduced and can be used as an intra-canal retainer associated with the resin composite as an alternative option for reconstruction of primary incisors greatly damaged by an extensive carious lesion. A more recent approach has used composite alone or in combination with other reinforcement material, and the use of fiber set in composite resin resulted in an increase in the strength of restoration.

In recent years, various types of fiber reinforcements have come into widespread use as an alternative to a cast or prefabricated metal post in restoration of endodontically treated teeth [18]. Along with ease of application, fiber can be used as an alternative to traditionally used materials in the management of early childhood caries [14]. The use of posts and cores enables more extensive reconstruction of grossly destructed anterior primary teeth. There are various materials such as prefabricated posts, metal posts, orthodontic wire posts, biologic posts, composite posts and fiber-reinforced posts that are available for this objective [15,17,19]. Prefabricated posts are fast, cheap and easy to use [20]. However, they do not take into account the individual shape of the root canal. Although metal posts are indicated for primary teeth, because of their color, metal posts do not meet the esthetic requirement. Moreover, these may cause problems during the course of natural exfo-
lation. Composite posts provide satisfactory esthetics; however, there is risk of loss of retention owing to polymerization shrinkage [21,22]. The use of omega-shaped stainless orthodontic wire as an intracanal post is also simple. However, the wire is unable to adequately adapt to the canal form because it is not the exact copy of the canal. Thus, polyethylene fiber is a recently developed material reported to have a clinical advantage over traditional post and core material [17,18]. These fibers improve the impact strength, modulus of elasticity and flexural strength of composite materials. When compared to other fibers, they are almost invisible in the resinous matrix. Due to these reasons, they are the most appropriate and the best esthetic strengtheners of composite materials [3]. In constructing the short posts, Ribbond was placed only in the cervical one-third of the canals to avoid interference with the process of permanent tooth eruption [17]. This combined technique of polyethylene fibers and composite resin provides excellent functional and esthetic results [23].

**Fixed space maintainer**

Various types of space maintainers can be used to avoid malocclusion as a result of premature loss of primary teeth. Removable appliances are one of these types of space maintainers. However, they may be broken or lost, and they provide inadequate treatment results if not worn as prescribed [24]. Properly designed and fixed appliances are another type of maintainer that can be used and are not only less of a nuisance to the child patient than removable appliances, but they are also less damaging to the oral tissue [25]. Polyethylene fiber-reinforced composite used as a fixed space maintainer offers many advantages. FRC has an esthetic appearance, is easily manipulated, can be quickly inserted in a single-visit procedure that requires no laboratory services, poses no risk of damage to abutment teeth and is easy to clean [24].

**Fixed partial denture**

With the increasing application of fiber-reinforced composites in dentistry, these materials also gain popularity in prosthetic applications. The development of FRC offers new possibilities in minimally invasive treatment approaches. Furthermore, FRC resin restorations have the advantages of good aesthetics, translucency, ease of repair, and an ability to bond to the abutment teeth, thereby compensating for less-than-optimal abutment tooth retention and resistance form. These materials also have the potential for chairside and laboratory fabrication [26].

Different therapeutic options can be considered for the replacement of a congenitally or traumatically missing permanent incisor teeth. Direct and indirect fiber-reinforced resin composite fixed partial dentures are a new way to produce minimally invasive, esthetic, and cost-effective metal-free tooth replacement. These treatment alternatives have a number of applications, such as chairside tooth replacements, long-term provisional, fixed partial dentures, and economically feasible tooth replacements, for patients who cannot afford more traditional treatment regimens [27]. As an alternative to the traditional restorations in anterior single-tooth deficiency, fiber-reinforced adhesive bridges, which are a more preventive, time saving and economical method, have been produced [28].

Congenitally missing teeth and conical lateral incisor teeth particularly seen on the anterior region in adolescents are an esthetically and functionally challenging situation for the clinician and the patient. As far as the relatively young ages of these patients are concerned, the restoration should be applied with a minimally invasive approach. Fiber-reinforced composite resin applications, which have recently become increasingly popular, can be considered as the treatment of choice in these cases, as they offer a minimally invasive fixed treatment option [29]. The loss of maxillary incisors in childhood has always been problematic, requiring immediate attention to restore both esthetics and function [30]. FRC prosthesis can be used for fixed tooth replacement following traumatic tooth loss in pediatric and adolescent patients. It is a more conservative treatment option than conventional fixed partial dentures and can be more cost-effective than other types of metal-free tooth replacements [8,31]. A preliminary retrospective clinical study by Piovesan et al. [32] suggested that polyethylene FRC fixed partial dentures (FPDs) could be a functional and esthetic alternative to replace a lost tooth. Unlu and Belli [33] concluded that polyethylene FRC FPDs functioned adequately during a mean clinical follow-up time.
of 3 years. In another report, a functional survival rate of 95% after a follow-up period of 4.3 years was described [34]. Also, for the child patients, this treatment could be considered as an interim treatment that can provide acceptable function and esthetics by replacing missing teeth and tissues until a definitive restoration can be performed. The patient’s natural tooth, an acrylic tooth, or composite resin can be used as a pontic [11].

**Splint**

Splinting teeth for periodontal, orthodontic, or post-traumatic 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 needed), 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 [35]. Tooth mobility has been described as an important clinical parameter in predicting prognosis [36,37]. For this reason and for patient comfort, splinting has been the recommended therapy to stabilize teeth. In the past, direct stabilization and splinting of teeth using an adhesive technique required the use of wires, pins, or mesh grids. These materials could only mechanically lock around the resin restorative. Because of this, there was the potential of creating shear planes and stress concentrations that would lead to fracture of the composite and premature failure. When the splint failed, the clinical problems that occurred included traumatic occlusion, progression of periodontal disease, and recurrent caries [38]. With the introduction of bondable, polyethylene woven ribbons, many of the problems with older types of reinforcement were solved [39].

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 [35]. Dental splinting is frequently needed following traumatic injury to stabilize subluxated, luxated, avulsed, or root-fractured teeth [40]. Many different types of splinting techniques have been described in the literature [41,42]. Ribbond can be used in the treatment of multiple displaced teeth. A Ribbond splint is esthetic, thin, smooth and non-irritating to the lip. The main disadvantage of this material is that it is relatively expensive [11].

**Conclusion**

Ribbond can be used as an alternative to conventional treatment in pediatric dentistry. However, long-term clinical studies are needed to evaluate the effects of prolonged use of Ribbond in pediatric dentistry [11].

**References**


