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Ribbond Fibers

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Certification

بِسْمِ اللَّـهِ الرَّحْمَـٰنِ الرَّحِيم

(فَتَعَالَى اللَّهُ الْمَلِكُ الْحَقُّ وَلَا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَى إِلَيْكَ وَحْيُهُ وَقُلْ رَبِّ زِدْنِي عِلْمًا). "سورة طه، آية: ١١٤".

(إِنَّمَا يَخْشَى اللَّهَ مِنْ عِبَادِهِ الْعُلَمَاءُ إِنَّ اللَّهَ عَزِيزٌ غَفُورٌ). "سورة فاطر، آية: ٢٨"|

(يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ). " سورة المجادلة، آية: ١١".

(اقْرَأْ بِاسْمِ رَبِّكَ الَّذِي خَلَقَ*خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ*اقْرَأْ وَرَبُّكَ الْأَكْرَمُ*الَّذِي عَلَّمَ بِالْقَلَمِ*عَلَّمَ الْإِنْسَانَ مَا لَمْ يَعْلَمْ). "سورة العلق، آية: ١-٥ ".

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DEDICATION

I Dedicate this project to :

My mother , who never stopped giving of herself in countless way,

My family who stand by me at every time

My supervisor who has been a constant source of support and Encouragement

And to all of the people who helped me in this project

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1. Introduction

Ribbond fibers introduced in 1992 to the market is a bondable reinforced fibers consisting of ultra-high 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.

The development of fiber-reinforced composite (FRC) technology has led to substantial improvement in the flexural strength, toughness and rigidity of dental resin composites. A number of materials for this type of reinforcement such as carbon, graphite, glass, Kevlar as well as other types of fiber have been considered and appropriate techniques for their use have been investigated. The findings of these studies have shown that both strength and fracture toughness can be increased because of their incorporation (***Goldberg AJ, Burstone CJ1992***). This increased toughness has been attributed to the transfer of stress from the weak polymer matrix to the fibers that have a high tensile strength ***(Nohrstrom TJ, Valittu PK, Yli-Urpo A***). Ultra-high strength polyethylene (UHSPE) fibers with higher specific strength, fracture toughness and chemical resistance than carbon, glass or Kevlar fibres were the next materials to be evaluated. It was found that the polyethylene fibres that were used initially were not satisfactory. UHSPE fibres are known to have a low melting point, high creep and, most importantly, a polyolefin backbone. An adequate interface bond between the fibres and various matrix resins is therefore difficult to achieve(***Li ZF, Netravali AN, Sachse W1992, Hild DN, Schwartz P1993***). They exhibit poor wetting properties and are difficult to bond because of low surface energies. Chemical inertness and the complete absence of polar groups on the fibres are additional factors(***Hild DN, Schwartz P1993***) . Different surface enhancements such as plasma spraying, flame and radiation treatment were then studied to improve the properties of the material. Chemical exposure to chromic acid or sulphonic acid invariably resulted in a significant loss of fibre strength***(. Postema AR, Pennings AJ. I 1988)*** . The addition of cold gas plasmas significantly improved adhesion of UHSPE fibres with epoxy matrices and higher interfacial shear strengths of plasma treated UHSPE.

2.Definition of Ribbond fibers

Ribbond is one such material, which has occupied an important place in the dentist's repertoire. It is bondable fibre reinforced material, made from the same ultra-high molecular weight polyethylene and ceramic fibers used to make bulletproof vests. The key to Ribbond's success is its patented leno weave. Designed with a lock-stitch feature, it effectively transfers forces throughout the weave without stress transfer back into the resin, providing excellent manageability characteristics. Having virtually no memory, Ribbond adapts to the contours of the teeth and dental arch. It is translucent, practically colorless and disappears within the composite or acrylic without show-through offering excellent esthetics. Ribbond's fibers are the standard in biocompatibility. The same material is also used in the construction of artificial hip and knee joints. By virtue of such wide spectrum of intended properties, it enjoys varied applications in day to day dentistry like: endodontic posts,periodontal splints, aesthetic space maintainers ,bondable briges and single bridges and orthodontic retainers. This paper is an attempt to showcase the versatility and applicability of this wonderful material in day-to-day dental practice***.(M. Ganesh and Shobha Tandon 2005)***

2.1 Fiber reinforced composites

Fiber- reinforced composites are resin-based materials containing fibres aimed at enhancing their physical properties. These were introduced first in the 1960s by Smith when glass fibres were used to reinforce polymethyl methacrylates.This group is very heterogenous one depending on the nature of the fibre, the geometrical arrangement of the fibres and the overlying resin material. The main materials used are glass, ultra-high strength polyethylene fibres and Kevlar fibres ***(M. Ganesh and Shobha Tandon)***.The arrangement of the fibres can be unidirectional with all fibres running in one direction or a weave or meshwork design fibres. The arrangement can be either braided fibres or woven fibres. The manufacturing method of these fibres can be either through resin pre- impregnated ones or the types, which require a chair-side impregnation method, either ways the end result is the same. Key factors which influences the physical properties of fibre reinforced structures are: Fibre loading within the restoration and Efficacy of the bond at the fibre resin interface, fibre orientation and fibre position in the restoration. Commonly used bondable reinforced fibres in clinical practice are: Ultrahigh molecular weight polyethylene fibers- Ribbond (Ribbond), Connect(Kerr), Glass Fibers- GlasSpan (GlasSpan) and fiber Splint ML(Polydentia), Fibers preimpregnated with resin Vectris (Vivadent), StickNet (StickTech) and FibreKor (Jeneric/ Pentron). ***(M. Ganesh and Shobha Tandon)***

2.2 Structure

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. For example; when making a periodontal splint, Ribbond tucks in interproximally without rebounding ***(M. Ganesh and Shobha Tandon)***. In addition, unlike loosely braided or bundles of unidirectional fibers, Ribbond does not spread or fall apart when manipulated. Since fiber reinforced resin structures derive their strength primarily from making laminates, high manageability and lack of memory is essential for close and accurate layering of the fibers. Inaccurate fiber placement results in voids or excessive composite on the tensile side of the fibers that will be prone to fracturing. The unique fibre design renders the following properties to Ribbond

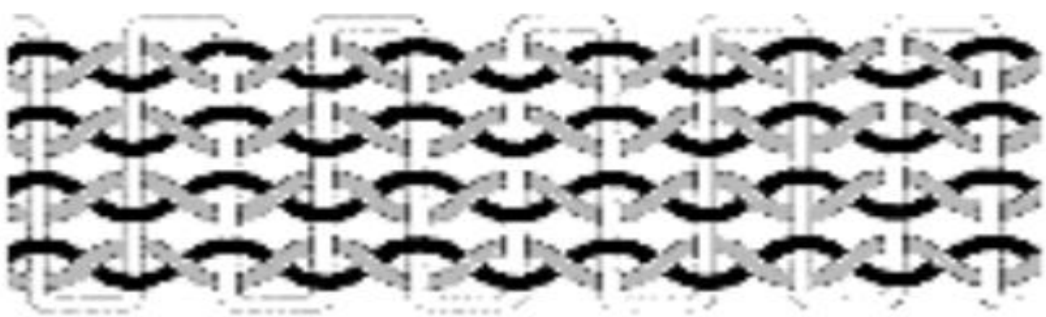

Figure 1: Unique cross-link lock stitch leno weave of ribbond fibers

Adaptable and Manageable. Does not unravel when cut or manipulated. Reinforces multi-directionally durable & impact absorbent. Transfers stresses efficiently throughout the fiber network. Other properties seen in Ribbond:

2.3 Properties of Ribbond

2.3.1 Highly Bondable

Ribbond bonds to any composite system. You choose the composite Magnified 110,000 time, SEM's demonstrate complete incorporation of the resin to Ribbond's fibers (note lack of voids). Forces within the resin are easily transferred to the fibers insuring that the Ribbond is an integral strength member of the prostheses. ***(M. Ganesh and Shobha Tandon)***

2.3.2 Bonding to Composites

Place the cut piece of Ribbond on a contaminantfree (having no wax or oil). Mixing slab, pad or lightsafe box and wet it with a few drops of unfilled bonding <adhesive, composite sealant or modeling resin. A "pit and fissure sealant" can also be used to wet Ribbond. Important: It is not recommended to wet the Ribbond with one step or 5th generation bonding systems. Sometimes these systems contain components (such as acids to etch the dentin or solvents) that can compromise the adhesion between the resin and the fiber ***(M. Ganesh and Shobha Tandon)***. To avoid diluting the filled composite resin, blot off the excess unfilled bonding adhesive with a lint-free gauze or a patient bib. It is easier to work with the Ribbond if it is not overly saturated with unfilled resin. Once Ribbond is wetted with unfilled bonding adhesive, it can be handled as you would touch resin (with powder-free gloves or clean fingers). To minimize premature setting of the unfilled composite on the Ribbond, protect the wetted Ribbond from the light until ready for use.(***S. Belli, H. Orucoglu, C. Yildirim, G. Eskitascioglu.2005)***

2.3.3 Esthetic

Ribbond is translucent, practically colorless and disappears within the composite or acrylic without show-through. Not only does Ribbond offer excellent esthetics, its translucency also allows the use of light cured composites. ***(M. Ganesh and Shobha Tandon)***

2.3.4 Biocompatible

Ribbond's fibers are the standard in biocompatibility. The same material is also used in the construction of artificial hip and knee joints. Unlike fiberglass, if at anytime the Ribbond is cut into with a rotary instrument, the resultant particles and exposed fibers will not be a biocompatibility risk to the patient. ***(M. Ganesh and Shobha Tandon).***

2.3.5 Versatile

The unique combination of strength, esthetics and bondability allows Ribbond to be used for many different applications. Ribbond bonds to both composite and acrylic giving you a material with multiple uses. ***(M. Ganesh and Shobha Tandon).***

3. Family Of Ribbond Fibres

Since its introduction in 1992 because of the increased demand for more ideal properties in the fibres with enhaced ease of application and reduced chances of any failure,today Ribbond has a family of fibres suited for different application in the day to day dental practice.It consists of :Ribbond THM,Ribbond original and Ribbond Triaxial .***(M. Ganesh and Shobha Tandon)***

3.1 Ribbond Original

Original Ribbond is a general purpose fiber reinforcement that can be used for the same applications as Ribbond-THM and RibbondTriaxial. It is thicker (0.35 mm) than Ribbond-THM. ***(M. Ganesh and Shobha Tandon)***

3.2 Ribbond-THM (thinner higher modulus)

Made from thinner fibers with a higher thread count, Ribbond-THM has a higher flexural strength than regular Ribbond and is only 0.18 mm thick. Ribbond-THM offers the same crack-stopping leno-weave and high strength fibers of Original Ribbond with greater manageability, greater easeof-use, and thinner results. Thinner RibbondTHM adapts more closely to the teeth with even less memory than Original Ribbond and stays better in place before curing. ***(M. Ganesh and Shobha Tandon)*** Not only is the finished prosthesis thinner, Ribbond-THM creates a smoother surface to the tongue. Ribbond-THM covers easier with composite with less show-through of the fiber. Ribbond-THM is designed for use with applications in which thinness and higher modulus are the primary concerns. These applications include periodontal splints, orthodontic retainers, endodontic posts and cores or short span anterior bridges. Original Ribbond is the preferred material for applications in which the final breaking strength is the primary concern. These applications include provisional bridges, composite bridges and reinforcement of removable prostheses. ***(M. Ganesh and Shobha Tandon).***

3.3 Ribbond Triaxial

The fibers in Ribbond Triaxial are oriented in a different design than our other Ribbond products. It is a hybrid of unidirectional and braided fibers forming a double-layered triaxial ribbon. This patented design provides significantly greater multidirectional fracture toughness and greater modulus of elasticity than our other Ribbond products. Ribbond-Triaxial is the material of choice for bridges, endodontic restorations, and other applications where strength ***(M. Ganesh and Shobha Tandon)***, modulus of elasticity, and fracture toughness is the primary concern. In addition to its greater strength and modulus of elasticity, another advantage of Ribbond-Triaxial for these applications is that it easily holds its form before polymerization and only requires one layer within the pontic area.Because Ribbond-Triaxial is thicker, it usually requires preparations. For applications in which preparations are not desired, Ribbond Triaxial can be used in conjunction with Ribbond-THM. ***(M. Ganesh and Shobha Tandon)***

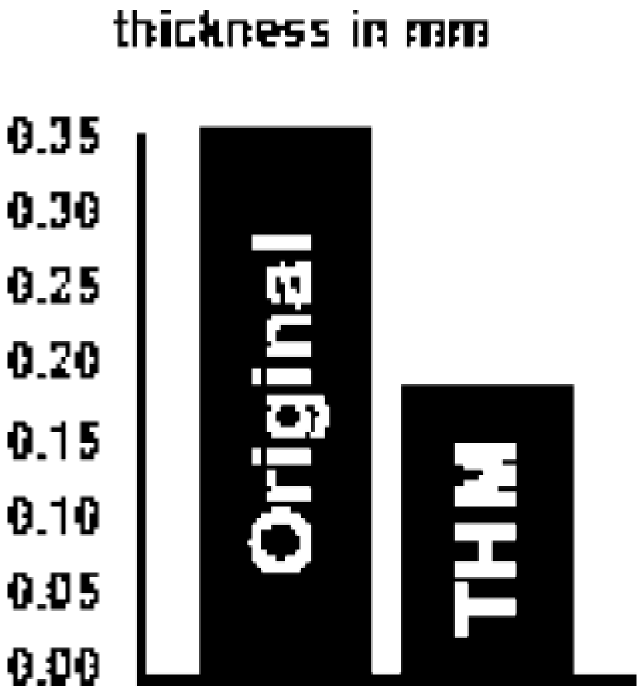

Figure 2.Comparison of thickness between Ribbond original & Ribbond THM.

4.Advantages

4.1 Micro-crack minimization and the reinforcement effect of UHMW polyethylene fiber

Fibre-reinforced restorations have an acceptable success rate***(Goldberg AJ, Burstone CJ 1992, Nohrstrom TJ, Valittu PK, Yli-Urpo A 2000)***. The physical properties of the materials used for these restorations are dependent on the type of composite material, the position, quantity, direction and form of the fibres, the fibre/matrix ratio, distribution of the fibres in the matrix and impregnation of the fibres with the polymer matrix***(Nohrstrom TJ, Valittu PK, Yli-Urpo A 2000, Altieri JV, Burstone CJ, Goldberg AJ, Patel AP 1994, Nielsen LE 1974, Valittu PK 1998, Karacaer Ö, Polat T, Tezvergil A, Lasila LVJ, Valittu PK 2003)***.

Application of a fibre layer in a restorative material might increase the load bearing capacity of the restoration and could prevent crack propagation from the restoration to the tooth. Fibre reinforced composites (FRC) effectively withstand tensile stress, and woven continuous FRC's have the potential to provide more consistent properties than unidirectional fibres because of the three dimensional structure resulting from the leno weave or triaxial braid***(Fennis WMM, Tezvergil A, Kuijs RH, Lassila LVJ, Kreulen CM, Creugers NHJ, Vallittu PK. 2005)***. The successful design of any structure requires in-depth analysis to predict and accommodate the stresses that will develop under anticipated applied loads***(Caputo AA, Standlee JP 1987)*** . The Finite Element Stress Analysis Technique allows the stress values throughout the structure under consideration to be measured accurately. Finite element analysis of FRC models have indicated that reinforcement with leno-weave polyethylene fibre (Ribbond Traditional) designed with a lock-stitch feature reduces stress values when compared with the unidirectional or diagonal (Ribbond Triaxial) type fibre designs under loading.***(6. Eskitascioglu G, Eraslan O, Belli S. 2006)*** (Figure 3- 5). Fibre design has a significant effect on both stress value and stress distribution and should therefore be taken into consideration when placing fibre reinforced restorations. When models are evaluated under laboratory conditions, structural failure of fibre reinforced materials generally occurs as a result of fibre fracture, matrix fracture or fibre-matrix interfacial bond fracture***(Latour RA Jr, Black J, and Miller B 1989***). In a typical application, the load is transferred from one fibre to another via the interface and matrix. When a fibre breaks, a strong interface is needed for the redistribution of loads from the broken fibre to the surrounding fibres in the matrix***(Hild DN, Schwartz P 1993)*** . If the fibre is unconstrained and is not obstructed along its length, a crack will traverse the entire length of the material resulting in substantial weakening. If the circumferential crack reaches a weak segment of the fibre, the fibre will break and disconnect (Figure 6***)(Gordon JE 1984).*** The use of transverse fibres such as those found in a leno-weave or triaxial braid limits the extension of this process between two sets of fibres. When a composite sample without fibre reinforcement is placed in a flexure, cracks appear on the tensile face and, due to the brittleness of the material, rapidly propagate causing failure. When a fibrous ribbon is placed in the composite resin, the fibres serve as crack stoppers and toughening agents and they provide a set of interfaces that prevent rapid crack growth. Minor cracks that do occur are constrained within areas subtended by interwoven fibres which then restrict their growth to small dimensions. Once the crack reaches the plane of the fibrous reinforcement, its forward path is blunted and it propagates along the weaker interface causing it to change direction (Figure 7). The use of UHMW reinforcement polyethylene fibres in polymethyl methacrylate-based provisional restorations prevents major crack propagation and this therefore becomes an effective method for the reinforcement of interim restorations***(Samadzadeh A, Kugel G, Hurley E, Aboushala A 1997).***

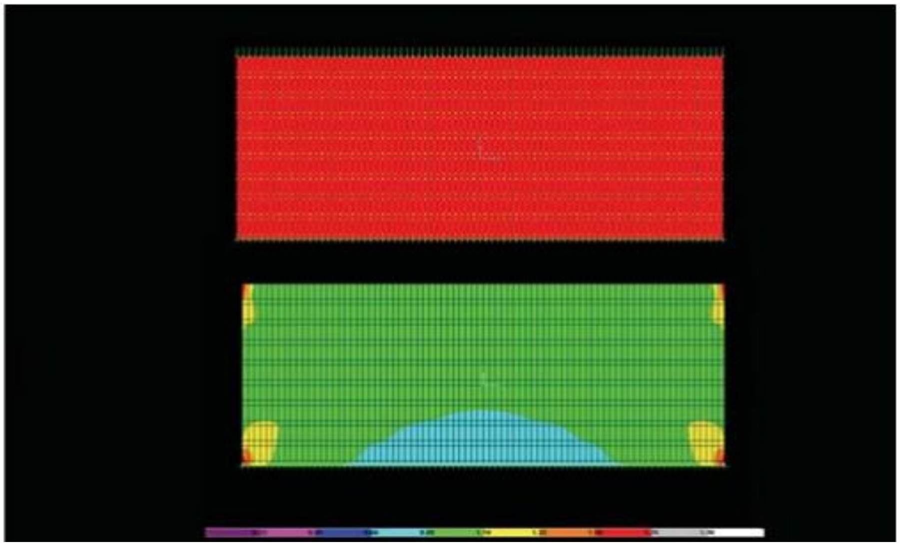

Figure 3. Stress distribution in the model representing unidirectional fibre design. All nodes at the bottom border of the model have been constrained. Load has been applied to all the nodes at top border of the model. An increased stress is observed in the corners (red–yellow;1.1-1.75 MPa). A homogenous stress distribution is observed all around the model (green; 0.88-1.1 MPa). This stress is reduced at the bottom of the model (blue; 0.66-0.88 MPa).

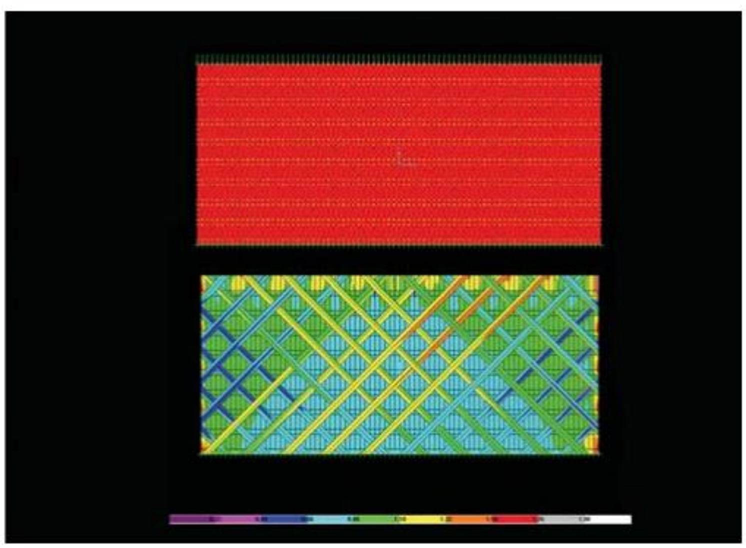

Figure 4. Stress distribution in the model representing diagonal type fibre design (Ribbond Triaxial). The colour scale indicates that stress is reduced throughout the model when compared to Figure 2. Diagonal fibres appear to absorb stress (yellow; 1.1-1.32 MPa)

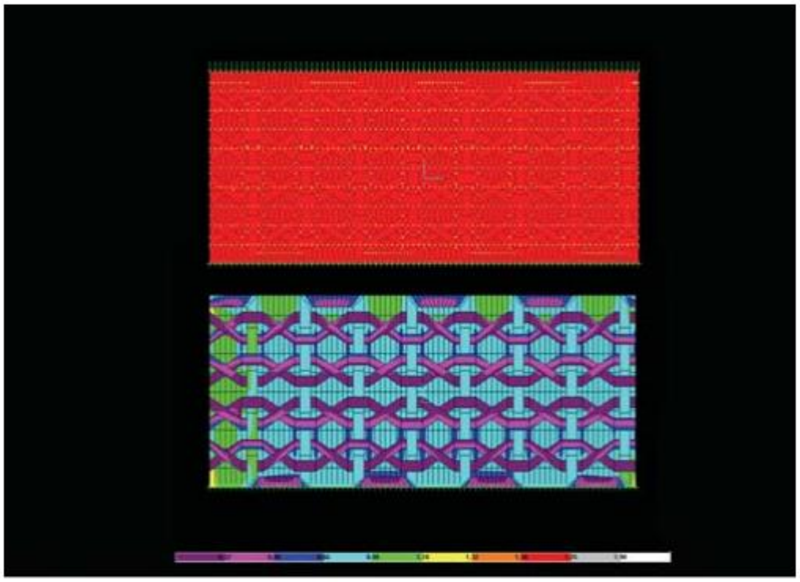

Figure 5. Stress distribution in a model representing leno weave-type fibre design with a lock-stitch feature (Ribbond Traditional). The stress values which were obtained in Figure 2 and 3 are reduced by 30% in this model (From 1.3MPa to 0.8 MPa). The high stress areas (green) are reduced and low stress areas (blue & violet) are increased when compared to the previous two models.

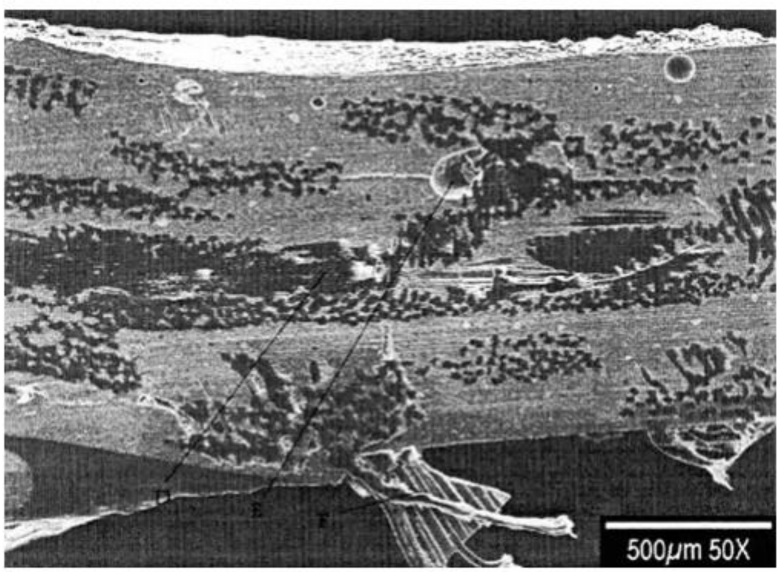

Figure 6. SEM image of composite resin reinforced with polyethylene fibre. fibre and horizontal crack in resin stopping at fibre (arrows) (With permission of Brendan F. Grufferty

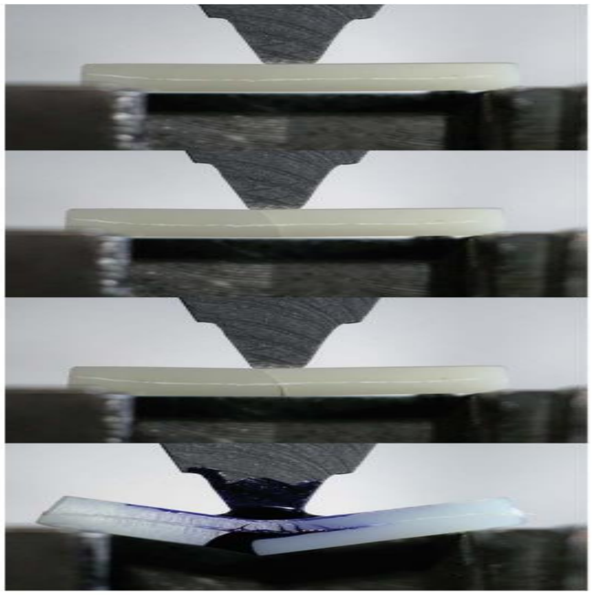

Figure 7. Failure of a Ribbond reinforced composite resin block under loading: a) A compressive load applied to the central of the resin block using a universal testing machine at a cross speed of 0.5mm/min; b) The crack hits the plane of the fibre reinforcement and a vertical crack is shown causing debonding along the fibre-resin interface towards the right; c) The crack continues to grow along the horizontal plane; d) The top half starts to crack as well but the thickness of the material prevents rupture.

4.2 Polymerization shrinkage reducing effect of UHMW polyethylene fibre

UHMW polyethylene fibre During the restoration of teeth, there can be appreciable loss of tooth structure including anatomic features such as cusps, ridges and the arched roof of a pulp chamber. As this loss could weaken the tooth, preservation of tooth structure is important for protection under occlusal loading. Unlike amalgam, bonded composite restorations usually strengthen the tooth. However, polymerization shrinkage remains a problem in extensive direct restoration with composites***(De Gee AJ, Feilzer AJ, Davidson CL 1993***) . Modifications that would reduce or eliminate the interfacial stress concentration within the composite restoration may increase the bond strength by increasing the force required to create and propagate a crack through the interfacial composite/adhesive bonding resin complex. The layer of collagen fibrils densely packed with resin may act as an inherent elastic buffering mechanism to compensate for the polymerization contraction of the restorative resin(***Van Meerbeek B, Williems G, Celis JP, Roos JR, Braem M, Lambrechts P et al 1993)***. The hybrid layer provides a stress modifying effect under composite or ceramic restorations***(Belli S, Eskitascioglu G, Eraslan O, Senawongse P, Tagami J 2005***) . Although the application of a low modulus intermediate resin between the bonding agent and the composite resin might relieve contraction stresses and improve marginal integrity(Kemp-Scholte CM, (***Davidson CL1990, Van Meerbeek B, Lambrechts P, Inokoshi S, Braem M, Vanherle G1992***), The higher modulus of elasticity and lower flexural modulus of the polyethylene fibre are believed to have a modifying effect on the interfacial stresses developed along the etched enamel/resin boundary***(Meiers JC, Kazemi RB, Donadio M 2003***) . Embedding a LWUHM polyethylene fibre into a bed of flowable resin under an extensive composite restoration increases both the fracture strength in root filled molars with MOD cavities(***Belli S, Erdemir A, Özçopur M, Eskita?c›o?lu G.***) and the microtensile bond strength to dentin(***Belli S, Dönmez N, Eskita?c›o?lu G 2006***), but decreases microleakage in cavities with a high c-factor(. ***Belli S, Orucoglu H, Yildirim C, Eskitascioglu G. 2005***). LWUHM polyethylene fibre's dense concentration of fixed nodal intersections assists in maintaining the integrity of the fabric enabling the stresses in the bulk of the material to be transferred more effectively due to well defined load paths from one area to another.

4.3 Effect of polyethylene fiber reinforcement on marginal adaptation of composite resin in Class II preparations

The incorporation of contemporary filler systems and monomer designs have also improved the physical properties of composite restorations(***Ástvaldsdóttir Á, Dagerhamn J, van Dijken JW, et al 2015 , da Veiga AM, Cunha AC, Ferreira DM, et al 2016***) However, volumetric contraction during the polymerization of monomers continues to limit their clinical longevity(***da Veiga AM, Cunha AC, Ferreira DM, et al.2016, 5. Song YX, Inoue K 2001***) As a composite resin cures, there is a volumetric dimensional change from 1% to 5***%.(Song YX, Inoue K 2001 , Ilie N, Hickel R. 2011***) When a composite resin is allowed to cure outside the dental cavity, the material is able to shrink freely. However, when a composite resin is bonded to a hard dentinal substrate, the volumetric shrinkage leads to the development of stresses at the restoration-tooth interface***.(Song YX, Inoue K.2001, Giachetti L, Scaminaci Russo D, Bambi C, Grandini R 2006***) If these stresses exceed the adhesive strength of the bonding system, marginal gaps will be formed at the interface, leading to marginal leakage and eventual bond failure***(. Braga RR, Ballester RY, Ferracane JL. 2005, Giachetti L, Scaminaci Russo D, Bambi C, Grandini R 2006)*** If the polymerization stresses are less than the adhesive strength, the stresses will be transmitted to the tooth structure, causing cuspal deflection and postoperative sensitivity***. (. Braga RR, Ballester RY, Ferracane JL. 2005, Giachetti L, Scaminaci Russo D, Bambi C, Grandini R 2006)*** The amount of polymerization shrinkage depends mainly on the amount of shrinkable monomers, which are eventually converted into polymers. ***(. Braga RR, Ballester RY, Ferracane JL. 2005, Giachetti L, Scaminaci Russo D, Bambi C, Grandini R 2006***) The magnitude of shrinkage stress depends on many factors, including material formulation, type and amount of filler particles, curing technique, and the geometry of the cavity preparation. ***(. Braga RR, Ballester RY, Ferracane JL. 2005, Giachetti L, Scaminaci Russo D, Bambi C, Grandini R 2006***) the gingival margin in Class II slot cavities restored ***with composite resin.(El-Mowafy O, El-Badrawy W, Eltanty A, Abbasi K, Habib N 2007***)The authors found that fiber inserts generally reduced the microleakage at the gingival margin in the dentin. However, the fiber insert was placed only at the gingival margin and not dispersed into the cavity. .(***El-Mowafy O, El-Badrawy W, Eltanty A, Abbasi K, Habib N 2007***) A recent study has proposed the use of polyethylene fibers in lining a fiber post to improve its adaptation to the root canal space.(***Aggarwal V, Singla M.2017***) It was hypothesized that if glass fibers were mixed with restorative resin, the amount of polymerizable resin would be reduced, which could result in better marginal adaptation

4.4 Strain and marginal evaluations

incorporating polyethylene fibers into a composite resin matrix improves the marginal adaptation of these restorations. Light curing of composite resins leads to polymerization of the organic matrix via free radical polymerization.(***da Veiga AM, Cunha AC, Ferreira DM, et al. , . Song YX, Inoue K. 2001***) As a result, the resin matrix changes from a pre-gel phase to a more viscous state.(***da Veiga AM, Cunha AC, Ferreira DM, et al. , . Song YX, Inoue K. 2001, Giachetti L, Bertini F, Bambi C, Scaminaci Russo D.2007)*** At this point, the material is able to relieve the contraction stresses.

5. Clinical use of Ribbond fibers

5.1 The use of Ribbond as a post-core material

Technique minimizes the chance for root fracture and has the following advantages.Comparesd to perforemed posts , there is no additional tooth removal after endodontic treatment. This maintains the natural strength of the tooth. Eliminates the possibility of root perforation. Because it made when the Ribbond is in a pliable state, it conforms to the natural contours and undercuts of the canal and provides additional mechanical retention. There are no stress concentrations at the tooth-post interface. The Ribbond post and core is passive . And highly retentive Furthermore, because Ribbond's translucent fibers take on the color characteristics of the composite it allows. For the natural transmission of light through teeth and crowns. This provides an exceptionally esthetic result (Hornbrook D.S. and Hastings J.H 1995, Iniguez I 20000 (Fig8). Ribbond is used in combination with composite resin (Ribbond Composite Laminate Endo Post and Cores). The physical properties of this material allow the conservative fabrication of aesthetic dowels and core foundations. As a result, what is produced is an aesthetic post core system that adapts to the root morphology individually (Figure 9).

Figure 8: Use of Ribbond for post and core preparation

figure 9. Ribbond composite laminate post core build-up adapts accurately to the root morphology. (Photo: Ribbond Inc. Seattle WA).

5.2 Constructing Periodontal Splints

By bonding a Ribbond-composite laminate tothe lingual of the teeth, you can construct a structural member that can stabilize periodontally involved teeth, act as a fixed orthodontic retainer, support a pontic, or retain an avulsed tooth. All these applications involve variations of a common technique. In general, it is easier to use the direct technique for the construction of periodontal splints, orthodontic retainers and splint-bridges using the avulsed tooth as the pontic. It is easier to use the indirect technique for the construction of bridges.

(Miller T.E. 1993)(Fig 10)

Figure 10: Splinting To Stabilize An Avulsed Or Traumatized Tooth Constructing Orthodontic Retainer

5.3 Ribbond in Orthodontics

is designed to be used only for post-orthodontic mandibular retainers for non-bruxing patients with 1/2 mobility or less. It can also be used to maintain maxillarydiastema closures when the relapse forces are passive. If the relapse forces are more active, the I-mm ultra narrow or 2-mm Ribbond should be used (figure 11)

Figure 11 : Ribbond in post orthodontic patients as retainers.

5.4 Cementing Ribbond bridges to the teeth

5.4.1 Anterior bridges

in general, the construction of directly bonded bridges is a variation of the splint construction technique. This procedure is best done indirectly. If the teeth are very mobile, the Ribbond framework should extend over additional abutment teeth for added stabilization.

5.4.2 Maryland Bridge Framework

Using A Denture Tooth As The Pontic: Direct Technique Because of the unpredictability of bonding acrylic resin to composite resin, it is not recommend using an acrylic denture tooth as a pontic for anything other than a provisional bridge. This technique is a variation of constructing an anterior bridge.

Select and fit a denture tooth to the pontic space. Construct and cure a Ribbond framework beam. Modify the denture tooth on the lingual so that it fits closely over the Ribbond framework. Cut exaggerated mechanical retention in the modified area. Sandblast the retentive area of the denture tooth and wet it with a heat cured monomer. Apply an unfilled bonding adhesive to the groove and cure it.. Fill in the retentive area of the denture tooth with hybrid composite resin and place it over the bemonomer. Apply an unfilled bonding adhesive to the groove and cure it. Fill in the retentive area of the denture tooth with hybrid composite resin and place it over the beam. Shape and smooth the composite resin. Light-cure the resin and check occlusion, finish and polish

5.4.3 Crown Retained Bridges

In Reinforcing an Acrylic Provisional Bridge Wet cut pieces of Ribbond with a runny mix of acrylic resin, lay them in the channel and cover with acrylic. If the Ribbond has a tendency to float to the surface, it can be pressed back into the channel with a doughy mix of acrylic.If possible, use multiple layers of Ribbond with acrylic between each layer.Ribbond does not polish well. Avoid cutting into the Ribbond fibers.

5.5 Composite Repairs

Wet the Ribbond with the unfilled adhesive resin, composite sealant or modeling resin and blot off the excess with a lint-free gauze, cloth or a patient bib. Do not use one-step or 5th generation resin to wet the Ribbond. Place a filled composite resin in the deepest area of etch channel. Compress the wetted Ribbond into the composite resin. Light-cure for 40 to 60 seconds. Apply an additional layer of filled composite resin and finish and polish. If possible, use multiple layers of Ribbond with composite between each layer.

5.6 Reinforce or Repair a Denture

Place the Ribbond as close to the oral-cavity side as possible, opposite the tissue surface on which the denture is pivoting. The greater the area covered with Ribbond, the stronger the repair will be. Follow the preceding directions for acrylic repairs

5.7 Restoration of tooth with poor prognosis

Fiber can increase the damage tolerance of a tooth. It can be used to provide additional support to weakened cusps and to span cracks. Fiber may also reduce the effective of the shrinkage of the restoration .

5.8 replacement of missing tooth

After one year of clinical use, direct construction of a single-tooth replacement using the natural tooth pontic still provided satisfactory esthetics and function. The technology which makes this adhesive restoration possible is the development of a high strength, high molecular weight, biocompatible polyethylene fiber. This easily handled material must be evaluated in long-term clinical studies. the esthetics and function obtained with this method were still satisfactory.the periodontal tissue did not show any response to the prosthetic device.

Fig 12 Clinical image of Ribbond base, before replacement of the tooth pontic.

Fig 13 Natural tooth pontic placed on the Ribbond base and cured for 40 s.

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