



CRA  
STATUS  
REPORT

## REINFORCEMENT FIBERS, FOR SPLINTING TEETH

Splinting teeth using cast fixed prostheses is a common procedure, but it is expensive, difficult, time consuming, often threatening to tooth vitality, & not easily repaired. Attempts to find alternative methods have used various metal fittings, mesh, & wires. Although successful, these techniques have not gained widespread clinical acceptance. Currently splinting teeth with reinforcement fibers embedded in composite resin has gained popularity. This method is inexpensive, easy, fast, minimally abusive to teeth, & repairable. Report below describes: (1) Common uses of reinforcement fibers for splinting teeth; (2) Advantages & disadvantages; (3) Technique for splinting teeth with reinforcement fibers; (4) Results of clinical & lab tests on several currently available fiber brands used for splinting; (5) Future trends; (6) Determining fees for splinting; & (7) CRA Conclusions.

### COMMON USES OF REINFORCEMENT FIBERS FOR SPLINTING TEETH

#### PERIODONTAL SPLINTING

Most common areas for periodontal splinting are lower & upper anterior teeth. Frequently, periodontally treated teeth are too weak to justify placement of conventional splinted fixed prostheses, but their condition does not justify extraction. Treatment with fixed prostheses is poor risk, both financially & clinically, because reduction in height of periodontal supporting structure forces tooth preparations onto root surfaces of small anterior teeth which challenges tooth vitality. However, this same condition of gingival recession provides ideal topography for fiber reinforced composite resin splinting because it opens interproximal embrasures without tooth reduction.

#### REPLACEMENT OF AVULSED TOOTH

Tooth stabilization necessary until supportive structures can regenerate can be accomplished well using reinforcement fibers & tooth colored composite on facial or lingual surfaces of avulsed teeth. When splint is no longer necessary, it is easily removed & tooth surfaces can be returned to normal appearance by smoothing & polishing.

#### TEETH WITH ORTHODONTICALLY WEAKENED SUPPORTING STRUCTURES

Tooth roots resorbed due to orthodontic movement often need long-term esthetic splinting. Composite resin & reinforcement fibers, generally placed on lingual surfaces, fill this need well. In situations where optimum opposing occlusal contacts are not present after completion of orthodontics, splinting can assist in maintaining teeth in proper positions for short or long-term service.

#### SPACE MAINTENANCE

Pediatric or adult teeth can be splinted to composite pontics with facial & lingual fibers. This type of space maintainer is easy to make, inexpensive, & requires minimal time—yet it is effective & relatively esthetic.

#### ADVANTAGES

- A. Simple, easy to understand concept.
- B. Relatively easy, fast technique.
- C. One appointment procedure is major time savings compared to some alternatives.
- D. Significant tooth structure removal not required.
- E. Tooth color satisfies most patient's esthetic needs.
- F. Inexpensive compared to most alternatives.
- G. Acceptable strength due to good integration of fibers with composite resin.
- H. Good clinical longevity.
  - I. Easily repaired.

#### DISADVANTAGES

- A. Composite resin portion of splint fractures occasionally, leaving fibers attached & creating multiple inaccessible areas where plaque accumulates, causing potential caries problem.
- B. Bulky composite/fiber combination must be avoided to prevent patient discomfort & dissatisfaction.
- C. Fibers protruding from resin are irritating to soft tissues. Conventional restorative composite resin or flowable resin must be placed superficially to avoid this situation.
- D. Oral hygiene can be challenging. Embrasures must be shaped & finished adequately to permit oral hygiene access.

## TECHNIQUE FOR SPLINTING TEETH WITH REINFORCEMENT FIBERS

Following is *representative technique* for splinting teeth. Consult directions with brand of fibers purchased for specific procedural details preferred by company. Generic technique has been included in this report to highlight necessary basic steps.

1. Clean teeth. Calculus, stains, plaque, & other debris must be removed completely from all areas of teeth intended for inclusion in splinting-bonding procedure. Leaving tooth structure uncleaned will cause splint to fail. Use strips, pointed diamonds, disks, pumice, etc.
2. Prepare dry field. This is obtained best with rubber dam. After rubber dam placement, Stim-U-Dent (J & J) or wooden toothpicks should be placed between teeth to preserve interproximal embrasures & reduce amount of finishing.
3. Roughen enamel & dentin with small, tapered diamonds to remove superficial fluoride layer & any debris missed previously in step 1. Occasionally, slot is cut in enamel for fibers if potential fiber bulk on tooth surfaces is considered objectionable.
4. Etch enamel & place dentin bond using products of clinician's choice. Dentin bond must be placed meticulously, since significant amount of splinting is on dentin surfaces.
5. Place first resin increment interproximally only, to ensure stable & proper tooth relationship, & facilitate subsequent placement of fibers.
6. Fiber placement. Estimate fiber strip length by placing piece of dental floss in area of splint. Cutting fibers can be challenging. (Some manufacturers include special instruments, but CRA found unused single edge razor blade cuts well on all brands of fibers tested. Also, some fibers unravel when cut & require resin placement & curing at position of proposed cut before cut is made.) After fibers are cut to correct length, wet fibers with unfilled bonding resin or a flowable resin. Place small amount of filled restorative resin on site intended for fiber placement & leave uncured. Press fibers into place using finger pressure & cure.
7. Place external resin, contour & cure.
8. Finish & polish splint using Midwest 7406 & 7901 burs, & strips, disks, rubber wheels, & prophylactic paste. If any fibers protrude from splint, small amount of flowable resin should be placed on surface to smooth roughness which is irritating to tongue &/or lips.
9. Adjust occlusion carefully to avoid excessive stress on stabilized teeth.

## RESULTS OF CLINICAL & LAB TESTS ON SEVERAL CURRENTLY AVAILABLE FIBER BRANDS USED FOR SPLINTING

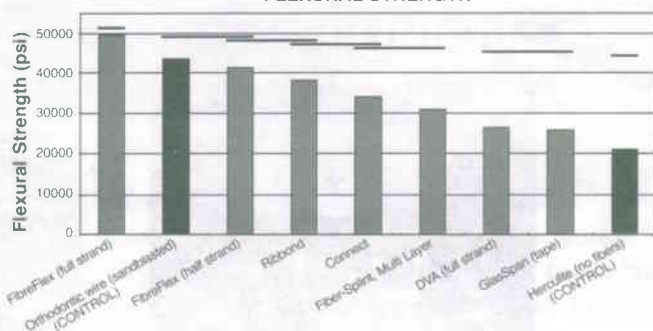
A. Chart below lists brands tested along with clinical characteristics & CRA Evaluators' observations.

BRAND (alphabetical order)	COMPANY	COST PER CM (refill kit)	PRIMARY COMPOSITION	CONFIGURATION & SIZES	CLINICAL CHARACTERISTICS
1. CONNECT	Kerr Phone: (714) 516-7400 Fax: (714) 516-7633	75¢	Polyethylene	Braided ribbon 2 & 3mm wide	1. Splays when cut. 2. Spreads when packed. 3. Does not adapt well to tooth surfaces. 4. Dispensed in 91cm roll—minimal waste. 5. Fair ease of use.
2. DVA	Dental Ventures of America Phone: (909) 270-0606 Fax: (909) 270-0636	2.5¢	Polyethylene	Tuft of individual fibers	1. Does not splay when cut. 2. Does not spread when packed, unless desired. 3. Adapts well to tooth. 4. Dispensed in 1524cm roll—minimal waste. 5. Good ease of use.
3. FIBER-SPLINT	International Dental Distributors Phone: (516) 544-4313 Fax: (516) 544-6123	67¢ — Regular (6 layers) \$1.07 — Multi-layer	Glass fiber	Woven ribbon 4mm wide	1. Does not splay when cut. 2. Does not spread when packed. 3. Does not adapt well to tooth surfaces—stiff. 4. Dispensed in 50cm roll—minimal waste. 5. Multiple protruding bristles. 6. Thick—requires 6 layers (Regular) or 1 piece of Multi-layer. 7. Fair ease of use.
4. FIBREFLEX	BioComp Phone: (805) 644-4892 Fax: (805) 644-4893	18¢	"Kevlar"	Tuft of individual fibers	1. Does not splay when cut. 2. Does not spread when packed, unless desired. 3. Does not adapt well to tooth. 4. Dispensed in 200cm roll—minimal waste. 5. Very thick bundle of fibers is both positive & negative. 6. Has yellow-gold color. 7. Poor ease of use.
5. GLASSPAN	GlasSpan Inc. Phone: (610) 363-7573 Fax: (610) 363-6391	\$1.26 — tape \$1.07 — rope	Glass fiber	Woven tape 2mm wide Braided rope 1, 1.5, & 2mm diameter	1. Splays when cut, & manufacturer recommends placing & curing resin at ends before cutting. 2. Spreads when packed. 3. Does not adapt well to tooth surfaces. 4. Dispensed in 8.5cm pre-cut pieces—encourages waste. 5. Fair ease of use.
6. RIBBOND	Ribbond Inc. Phone: (206) 340-8870 Fax: (206) 382-9354	\$1.47	Polyethylene	Woven ribbon 1, 2, 3, 4, & 9mm wide Braided orthodontic ribbon 1mm wide	1. Does not splay when cut. 2. Does not spread when packed. 3. Adapts well to tooth. 4. Dispensed in 22cm pre-cut pieces—encourages waste. 5. Excellent ease of use.
7. ORTHODONTIC WIRE (CONTROL)	Orthodontic supply source	7¢	Stainless steel	Single strand wire 0.36 - 1.30mm diameter	1. Does not splay when cut. 2. Does not spread when packed. 3. Does not adapt well to tooth surfaces. 4. Dispensed in 36cm pieces—encourages waste. 5. High rigidity. 6. Must sandblast to gain adhesion. 7. Fair ease of use.

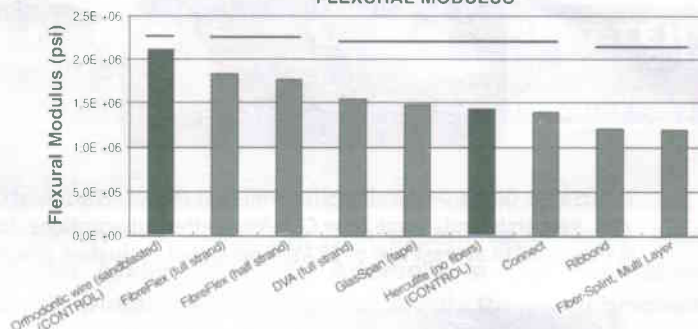
**SUMMARY OF CHART:** Although fiber cost varied by factor of 50, importance of ease of use far outweighed cost. 11 clinicians who used all fibers stated preference for most costly brand—Ribbond. Most obvious clinical difference related to 3 compositions sold was cutability. Only glass could be cut with conventional scissors, & polyethylene & Kevlar required special scissors sold by Ribbond & GlasSpan companies. However, CRA found unused single edge razor blade cut well on all compositions tested. Of current fiber configurations, CRA Evaluators reported weaves & braids much easier to place. Weaves held shape best when cut & could be adapted well to curvature of teeth & arch; braids adapted particularly well if stretching on bias was indicated, but they tended to splay or unravel when cut; & tufts of single strands were most difficult to guide & control during placement.

B. Graphs below show results of CRA laboratory tests on fiber tufts & tapes bonded into tension side of Herculite resin samples (2mm x 3mm x 25mm) using All-Bond 2 as adhesive. Controls included samples without reinforcement (all resin) & sandblasted orthodontic wire embedded in adhesive & resin. (See full methods & results on CRA's web site, www.cranews.com).

FLEXURAL STRENGTH



FLEXURAL MODULUS



**OVERALL SUMMARY OF 2 GRAPHS:** Flexural Strength numbers indicate all fibers tested added strength to Herculite resin under flexural load. Although FibreFlex in its full tuft had highest flexural strength, clinicians noted full strand bulk was not generally usable, so CRA tested FibreFlex at half strand also. Flexural Modulus numbers express degree of flexibility, with highest numbers showing most rigidity. As expected, orthodontic wire bonded to the resin was most rigid. Although statistical analyses indicate superiority of some fibers in the 2 tests, clinically these differences have not correlated with better performance. All fibers tested have withstood clinical forces applied to splinted teeth, & no cases of breakage or debonding have been reported at 1 year. Longer term clinical data will be reported as time passes.

## FUTURE TRENDS

Fiber reinforcing resins are coming forth in many new & innovative applications such as: (1) Posts & cores & (2) Pressure & vacuum molded copings for all-resin crowns & fixed prostheses. All are new uses of fibers, & all need careful long-term testing before incorporation in practice as routine procedures.

## DETERMINING FEES FOR SPLINTING

Clinical experience shows about 30 - 60 minutes is needed to splint 6 anterior teeth. However, treatment time can vary substantially depending on number of teeth splinted, complexity of case, & clinician's experience.

Third party codes— SPLINTING: 04320 = splinting, intracoronal; 04321 = splinting, extracoronal.  
SPACE MAINTENANCE: 01515 = space maintainer, bilateral; 01510 = space maintainer, unilateral.

## CRA CONCLUSIONS:

Clinically, all fibers tested are working well for splinting at one year of service. Although no one brand is more successful in terms of stabilizing teeth & longevity of service, Ribbond reinforcement fiber has best ease of use. Orthodontic wire remains useful because it has best rigidity & long-term clinical record. As long-term data on reinforcement fibers are acquired, an update report will be given.

# What is CRA?

## WHY CRA?

CRA was founded 23 years ago by clinicians who believed practitioners could confirm efficacy and clinical usefulness of new products and avoid both the experimentation on patients and failures in the closet. With this purpose in mind, CRA was organized as a unique volunteer effort where clinicians worldwide unite their expertise for the sole purpose of testing all types of dental products and disseminating results to colleagues throughout the world.

## HOW DOES CRA FUNCTION?

Each year CRA tests in excess of 650 different product brands, performing about 20,000 field evaluations. CRA tests all types of dental products, including materials, devices, and equipment, plus techniques. Worldwide, products are purchased from distributors, secured from companies, and sent to CRA by clinicians, inventors, and patients. There is no charge to companies for product evaluations. Testing is performed by combined efforts of 400 clinicians in 18 countries who volunteer their time and expertise, and over 40 on-site basic scientists, engineers, and support staff. Every product is subjected to at least 2 levels of CRA's unique 3-tiered evaluation process that consists of:

1. CLINICAL FIELD TRIALS where new products are incorporated into routine use in a variety of dental practices, and compared by clinicians to products and methods they use routinely.
2. CONTROLLED CLINICAL TESTS where new products are used and compared under rigorously controlled conditions, and patients are paid for their time as study participants.
3. LABORATORY TESTS where physical and chemical properties of new products are compared to standard products.

## WHO FUNDS CRA?

Research funds come from subscriptions to the CRA Newsletter. Revenue from CRA's 17 "Dentistry Update™" courses support payroll for non-clinical staff. All Clinical Evaluators volunteer their time and expertise. CRA is a non-profit, research institute. It is not owned in whole or in part by any individual, family, or group of investors. This system, free of outside funding, was designed to keep CRA's research objective and candid.

## THE PROBLEM WITH NEW DENTAL PRODUCTS.

New dental products have always presented a challenge to clinicians because, with little more than promotional information to guide them, they must judge between those that are new and better, and those that are just new. Due to industry's keen competition and rush to be first on the market, clinicians and their patients often become test data for new products. Every clinician has, at one time or another, become a victim of this system. All own new products that did not meet expectations, but are stored in hope of some unknown future use or thrown away at considerable loss.

CRA's motto is **CLINICAL SUCCESS IS THE FINAL TEST.**

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