Stacked for Success by Drs. Isaias Íñiguez and Laiza Íñiguez Smith

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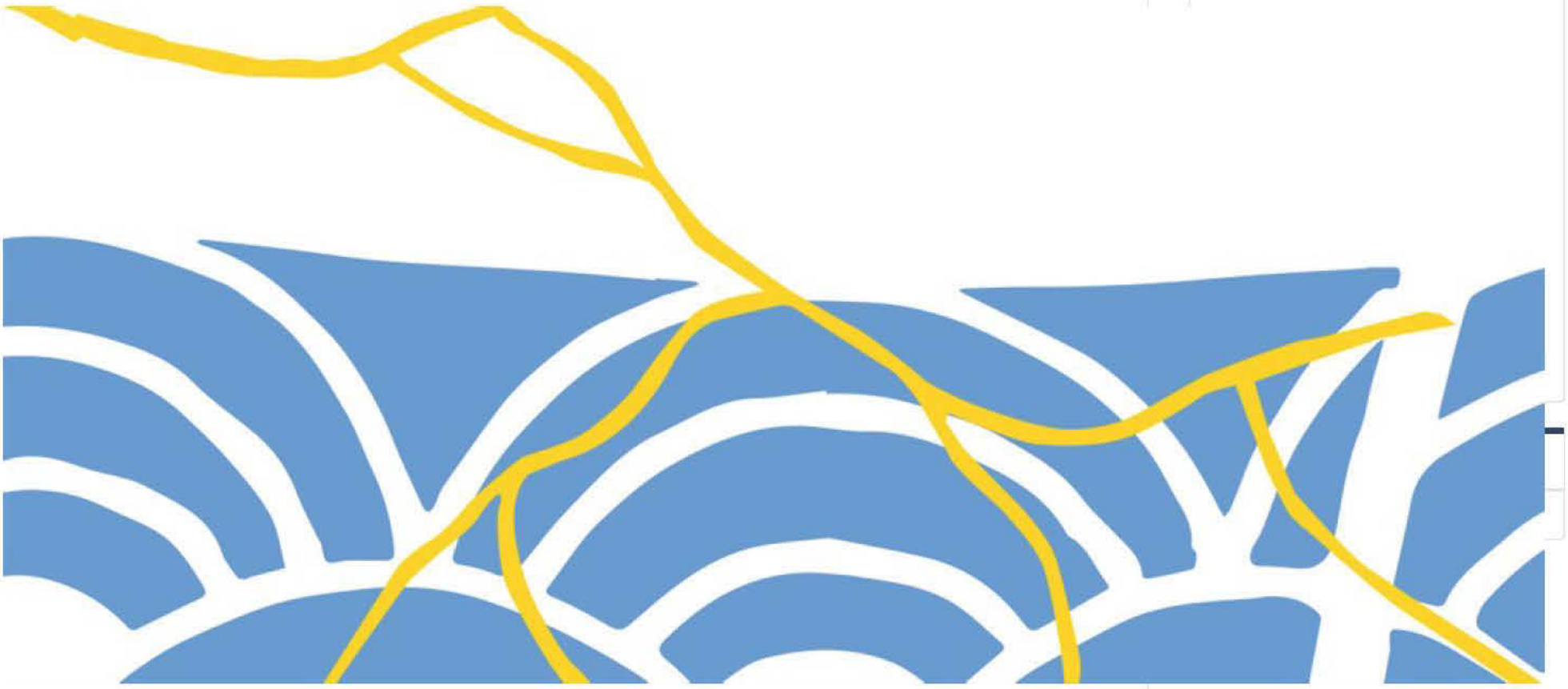

Layering bulk-fill composite and high-strength fibers to treat a cracked tooth can create an interim treatment that lasts 10 years and counting

by Drs. Isaias Íñiguez and Laiza Íñiguez Smith

"Cracked tooth syndrome" refers to an incomplete fracture of a vital posterior tooth. It incorporates the dentin and sometimes continues into the pulp. The designation of cracked tooth syndrome was presented early on by Cameron in 1964.[1] Previously, references existed of pulpal discomfort initiating from a partial tooth fracture.[2]

The diagnosis, treatment and prognosis depend on the extent of the fracture, the intervention time and the restoration type. These are crucial parameters in determining the treatment outcome. A tooth stress or fracture plane may be completely supragingival and may or may not intersect the pulp chamber.[3] A partial fracture (Figs. 1 and 3) is potentially noncatastrophic. Such teeth can be restored with a direct restoration, a crown (Figs. 2 and 4), or an endodontic procedure with post/core and crown.

A fracture can be catastrophic when it involves the periodontal attachment. That would be nonrestorable. To avoid irreversible damage, it is imperative that a cracked tooth be treated as soon as possible.[4] Immediate immobilization using an extracoronal or intracoronal splint should be employed. Traditionally, crowns are used as preventive treatment for fractured teeth; however, full crowns can increase the risk of tooth fracture, particularly with endodontic treated teeth. Full crowns are described as the least desirable option[5] and should be avoided unless it involves re-treatment of a previously crowned tooth.

Studies demonstrate that posterior composites have an acceptable long-term clinical performance when clinicians follow certain clinical parameters.[6] If clinicians are adequately skilled and familiar with most adhesive dentistry secrets, they will perform beyond the indications of direct restorations into a more destroyed tooth.[7] Composite restorations have become routine because of patients' increasing aesthetic demand and the high survival rates of restorations placed in large cavities.[8]

This article describes two different direct composite restoration techniques to treat cracked tooth syndrome:

- One technique involves two layers of bulk-fill composite (SonicFill from Kerr), with high-strength polyethylenefibers (Ribbond) encrusted between them.
- The other uses three layers of composite, with pieces of high-strength polyethylene fibers between each.

Fibers increase the damage tolerance of a tooth, and can also be used to provide additional support to weakened cusps and to small cracks.[9]

Case 1

The bulk-fill technique has been suggested in an attempt to simplify steps, seriously reducing procedure time and making us much more efficient.

A 68-year-old patient presented complaining of cold sensitivity, along with pain upon chewing, and requested an immediate solution. The clinical examination and X-ray demonstrated a failing Class II resin restoration in Tooth #13 (Fig. 5a). A preoperatory periapical X-ray was taken (Fig. 5b). A mesial–distal crack was present with no apparent periodontal pocket. All other maxillary teeth were checked and found asymptomatic. The diagnosis was cracked tooth syndrome.

The patient was advised against the questionable long-term prognosis of cracked teeth, yet decided to keep it. She understood if the crack extended into the root, a periodontal pocket could develop. An extraction and an implant replacement may then be indicated.

A rubber dam (split dam technique) was placed to achieve isolation. This technique is essential, per the UCLA restorative recommendation, and no other isolation method provides better control over fluids and moisture contamination,[10] removal of the failing composite restoration and infected dental structure are effectuate. No additional dentin should be removed beyond what is needed.[11] The preparation was complete, with all internal angles rounded to reduce stress concentration (Fig. 6). This improves composite resin adaptation to the dental structure.[12] No bevels were placed on occlusal or gingival margin. A standard Tofflemire metal band was placed to protect the adjacent tooth.

Every surface was etched (MicroEtcher, Danville Materials) with 35 microns (Crystal Air, Crystalmark Dental Systems) to increase the bond strength.[13] Two percent chlorhexidine (Cavity Cleanser, Bisco) was applied to disinfect the preparation, then gently air-dried. After removing the Tofflemire band, a contact matrix ring was placed (Fig. 7), along with wedges and a sectional metal band (Garrison Dental Solutions). The primer (OptiBond XTR, Kerr) was applied with moderate pressure for 30 seconds (Fig. 8), then gently air-dried before applying adhesive (OptiBond XTR, Kerr) using gentle agitation (Fig. 9) for 15 seconds.

The bulk-fill technique included two layers, beginning by applying one small increment of bulk composite (SonicFill, Kerr, Fig. 10), then two 2mm pieces of high-strength polyethylene fibers (Ribbond) blotted with an unfilled bonding adhesive. Excess was removed with lint-free gauze. The fibers were firmly inserted into the uncured composite in the mesial–distal direction (Fig. 11). The other piece of high-strength polyethylene fibers was tightly introduced onto the uncured composite in the buccal–lingual direction (Fig. 12). The fibers were adapted and pressed (Fig. 13) as close to the pulpal floor as possible, then light-cured. This increment will be the base or liner (Fig. 14). Lastly, the thickest increment was applied with the same bulk composite.

Tints (Color Plus, Kerr) were placed to create tertiary anatomy (Fig. 15). Glycerin was placed on all surfaces to avoid the oxygen inhibition layer, ensuring total polymerization of the composite, then light-cured[14] (Fig. 16). The rubber dam was removed and occlusion was inspected in all eccentric movements to avoid any premature contact.

Then, the contoured restoration was polished with intraoral polishing paste (DiaShine, VH Technologies), using a latch brush and keeping light in constant contact with the restoration. This provides higher surface luster (Fig. 17a). As a preventive measure for occasional bruxism, the patient was provided with a night guard.[15] A postoperative periapical X-ray was taken (Fig. 17b).

We explained to the patient that this is a temporary aesthetic fix, done to facilitate further treatment planning. It does not represent a definitive treatment solution. So far, the restoration has survived an eight-year follow-up (Fig. 18). We did not find the presence of crack extension into the pulpal floor. To this day, the patient has decided to leave the restoration untouched.

At this time, the only part of the treatment I'd do differently today would be to use Ribbond Securing Composite, only because it is ideally used for Ribbond fiber adaptation. It also allows for easier placement.

Fig. 1

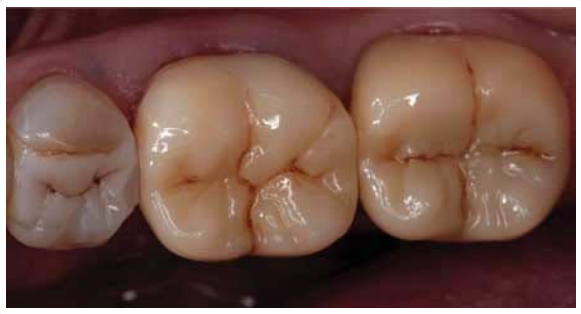

Fig. 2

Fig. 3

Fig. 4

Fig. 5a

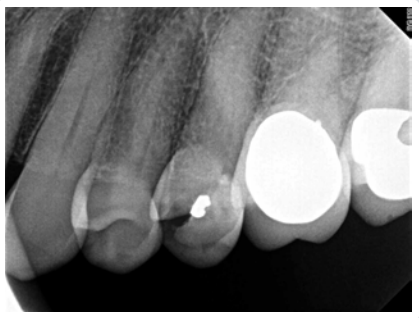

Fig. 5b

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17a

Fig. 17b

Fig. 18

Case 2

Layering technique: The use of incremental layers helps decrease stress generated by composite polymerization shrinkage, because it reduces the configuration factor.[16]

A 65-year-old patient came in for a routine checkup, with no complaints of sensitivity or other symptoms. Examination revealed that Tooth #15 displayed numerous cracks into the dentin (Fig. 19), which indicated a structurally compromised tooth. The dentin cracks were a result of flexing under function of the tooth weakened by an old occlusal amalgam.

It is appropriate to treat cracks even when a patient demonstrates no symptoms, because 50–100-micron openings allow for bacterial growth and penetration into the dentin. Untreated cases ultimately result in a fractured tooth, requiring endodontics, periodontics or possible extraction.

Again, total isolation was achieved with a rubber dam. After amalgam removal and preparation completion, all internal angles were rounded (Fig. 20) to reduce stress concentration. This improves composite resin adaptation to the dental structure. No bevels were placed on occlusal or gingival margins. Tooth structure bond strength was increased after sandblasting (MicroEtcher) with 35 microns (Crystal Air). Thirty-five percent phosphoric acid (Select HB Etch, Bisco) was applied for 15 seconds, then washed thoroughly. To avoid bond strength degradation,[17] an antibacterial agent such as chlorhexidine 2% (Cavity Cleanser) was applied for 30 seconds, with excess eliminated with sterile sponges. In this case, etch rinse adhesive (OptiBond FL, Kerr) was also used

Multiple layers of primer were applied, then left alone for 40 seconds to dry and evaporate the solvent. In this layering technique, three different composite layers are used.[18] First, a warm composite layer is placed on the pulpal floor; next, two 2mm-width pieces of high-strength polyethylene fibers (Ribbond) that have been blotted with an unfilled bonding adhesive. The excess is eliminated with lint-free gauze.

One piece of fiber is firmly inserted onto the uncured composite in the mesial–distal direction (Fig. 21), while the other is firmly inserted in the buccal–lingual direction (Fig. 22). The fibers are adapted and pressed as close to the pulpal floor as possible, then light-cured.

In one study, SEM found when fibers were inserted into the proximal box depth, little or no microleakage took place, and microtensile bond strength increased the dentin in cavities with high C-factor. Another layer of composite was applied (Fig. 23). The final buildup was done with a prewarmed restorative composite (Tetric EvoCeram, Ivoclar Vivadent) to increase durability.[19] Tints (Color Plus) were placed to create a tertiary anatomy (Fig. 24), then light-cured. After removing the rubber dam, the occlusion was adjusted and remained with light centric contacts. The pointy cusps of opposing teeth were smoothed to reduce tensile forces.[20]

Next, the restoration was contoured, then polished with an intraoral polishing paste (DiaShine) using a latch brush. A light, continuous contact is kept to provide a higher surface luster. A sealant layer (OptiGuard, Kerr) was applied to seal the small cracks from finishing procedures (Fig. 25). As a preventive measure for occasional bruxism, the patient was provided with a personalized night guard.[15]

The restoration has kept up at its 10-year follow-up, demonstrating an absence of any crack extension into the pulpal floor (Fig. 26). As in Case 1, the only thing I'd do differently today would be to use Ribbond Securing Composite, for easier placement and ideal adaptation of Ribbond fibers to the teeth.

Fig. 19

Fig. 20

Fig. 21

Fig. 22

Fig. 23

Fig. 24

Fig. 25

Fig. 26

Discussion

A cracked tooth can act as a pathway for bacteria that may induce pulpal or periapical inflammation or disease.[21] Complex restorative and endodontic treatments that remove dentin compromise the internal strength of the tooth, making it susceptible to fracture.[22] Cracked teeth are common and challenging[23], and may be caused by excessive forces from mastication or malocclusion. Large or normal forces could weaken the tooth.[24]

The multidirectional Ribbond fibers bridging the crack act like basket-woven stitches that transfer stress to a region of greater structural integrity.[25] When fibers are placed on a restoration's occlusal surface from a buccal to lingual direction, significantly higher fracture resistance is observed.[26] Microtensile bond strength increases the dentin in cavities with high C factor.[27] It is crucial to leave the restoration with sufficient strength to survive occlusal stress, particularly if the restoration is subjected to the same forces that initiated the original failure.[28]

The data indicates that composite resin is a technique-sensitive restorative material that can be used in large preparations, if proper manipulation and isolation are maintained.[29] As oral health providers, we are always looking for the best treatment modalities for our patients.[30]

Conclusion

Once cracks are detected in an early state, an immediate direct reinforced restoration would provide protection and could save many teeth. If the tooth with a crack is left without treatment, a bacterial penetration could form, resulting in inflammation and disease. Ribbond fibers bridge the cracks that are commonly seen in the pulpal floor of old amalgams and resin restorations. The fibers act as a staple, holding both sides of the crack together. By adapting the fibers closely to the dentin, the clinician can increase tooth toughness and prevent the existing dentin crack from propagating and failure. Direct adhesive restorations require a lot of attention to detail.

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