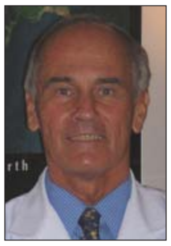
Immediate Post-Extraction In Situ Direct Lamination Composite Bridge



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Certain journal articles have advanced the growing trend in clinical prosthetic dentistry to accept and use direct placement, light-cured composites—traditional filling composites—for the purpose of direct tooth replacement in select situations.[1,2] This trend is also noted with materials used in an indirect methodology, such as fiber-reinforced composites[3] as well as a heat-, light-, and self-curing composite used for inlays, onlays, bridges, and splints.[4-7] This concept was also featured in *Popular Mechanics* magazine in 1998 as the "No Grind Dental Bridge."[8]

This article presents a technique for the direct replacement of single or multiple teeth at the time of tooth extraction with conventional composite filling materials without fiber reinforcement.[9]

In the course of one's professional career dentists may be faced with situations in which an irreversibly damaged anterior tooth, or multiple anterior or bicuspid teeth, must be extracted due to infection, pain, or injury. Alternatives in treatment abound, but a simplistic and powerful alternative has eluded us until now.

Figure 1. Tooth No. 8 is abscessed, hypererupted, rotated facially, and requires immediate extraction.

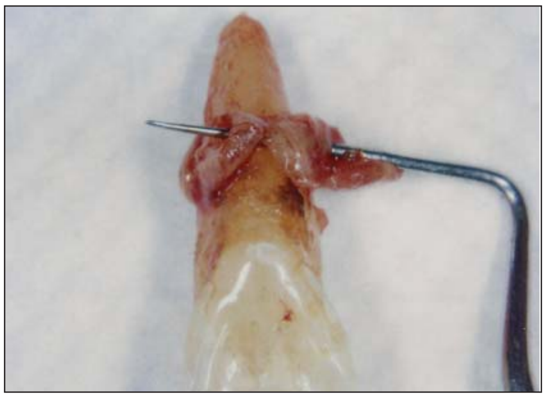

Figure 2. Extracted tooth shown with periodontal probe piercing abscess attachment at mid-root level.

Figure 3. After curettage of alveolus with surgical No. 8 round bur and hand instruments, a 4.0 resorbable suture is placed to secure the wound. Before extraction, the old mesial resin filling had been removed and teeth Nos. 7 and 9 cleaned with pumice and diamond burrs.

Figure 4. The CS is constructed with impression putty mixed by hand and placed from the lingual-palatal extending toward the labial vestibule, as seen here, to form the facial platform.

DISCUSSION OF COMPOSITE FIBER REINFORCEMENT

The procedure presented in this article does not (contrary to conventional wisdom and opinion) require fiber reinforcement to strengthen the composite comprising the immediate post-extraction in situ direct lamination composite bridge (PEB). The contrary has been shown by the research and demonstrations of Knight and Whittaker.[10] Additionally, fiber reinforcement has been implicated in the premature failure of composites by Rudo and Karbhari in their article "How Fiber-Reinforced Composite Materials Work" by stating the following:

"It is difficult to compare the performance properties of various fiber configurations by just subjecting them to the standard dental testing protocols…Although the function of the fiber composite material in different applications is extremely complex, a basic description of the function of fiber composite materials provides a useful understanding of the mechanism. When loaded in a longitudinal tension or fatigue, brittle matrix composites reinforced with high strain to failure fibers exhibit either multiple mode I cracking (opening) followed by sliding between the fiber and composite matrix, fiber failure, and pullout or fracture by the growth of a single crack. Although the formation of matrix composite cracks degrades the integrity of the composite, it is possible for the fibers to support a load if reinforced with fibers that have a higher strain to failure than the matrix composite."[11]

Thus, it may be discerned that fibers may hold together the fractured composite to some degree, but do not in fact prevent it from fracturing. This fact challenges the assumption that fiber-reinforcement makes the composite material "stronger," which most clinicians presume and accept as indisputable. Unlike Knight and Whittaker, Rudo and Karbhari did not use a 3-point test showing transverse strength being either enhanced or otherwise. Knight and Whittaker[10] tested the bend strength of 3 groups of composite materials: (1) control composite, (2) composite with fiber, (3) composite with nylon mesh. They found that Group 1 (fiberless composite) had the highest bend strength (See Table 1). Fibers may be used more often to hold a restoration together than for strengthening. From the research of both Rudo/Karbhari and Knight/Whittaker, one may conclude that

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Table 1 Bend strength values of three groups tested.

Groups	Bend Strength (Mpa)	Standard deviation
Group 1 (Control)	157.8	16.17
Group 2 (Ribbond)	140.5	14.92
Group 3 (Nylon mesh)	107.5	21.53

fibers of this nature inserted within stock composite may weaken, not strengthen.

The approach being presented has many advantages: (1) there is only one appointment needed for tooth extraction and bridge fabrication; (2) cutting of the existing tooth structure is not required, other than removal of fillings, calculus, old crowns, plaque, or stains; (3) there are no messy impressions; (4) a temporary bridge does not need to be fabricated; 5) laboratory procedures are not needed; (6) metal-to-porcelain is not used, therefore no micro-currents; (7) there is no waiting for the finished bridge; (8) contours and shade can be adjusted immediately; and (9) savings in cost and complexity of procedures for the patient and doctor are obvious.

TECHNIQUE: DEMONSTRATION OF IMMEDIATE BRIDGING

In Figure 1, the patient's tooth No. 8 must be removed immediately. It had been treated endodontically years ago and developed apical pathology. The patient had intense pain, swelling, drainage, and malodor. The incisal migration and rotation facially is notable. This condition interfered with occlusion to such an extent that the patient was prevented from closing the molar teeth together in chewing.

Figure 2 is a closeup view of the extracted tooth with a periodontal probe piercing the soft tissue attached to the mid-root level. After the tooth was removed, it was sent to Queen's Hospital in Honolulu, Hawaii for histopathological review by a board certified pathologist, disclosing an endo-perio abscess.

Figure 3 shows the wound site and the resorbable suture holding the margins together. Prior to the extraction of tooth No. 8, teeth Nos. 7 and 9 were cleaned with pumice. The old, stained mesial-facial filling was removed prior to PEB in situ fabrication, before the stent fabrication, and before the bridge was constructed.

The Carlson Stent (CS) was next constructed at chairside. Impression putty was mixed by hand and placed from the lingual-palatal extending the facial platform toward the labial vestibule, as seen in Figure 4. (Note: In construction of the PEB for this circumstance, the lingual aspect was used for the majority of the support and attachment of direct composite filling material to support teeth Nos. 7 and 9. One may note in Figures 5 to 9 that the facial margins are minimal, ending at the facial-mesial line angles of teeth Nos. 7 and 9. Not shown is the lingual thickness, or "lingual wings," embracing the lingual concavities.)

The stent was removed after hardening and was trimmed with an acrylic bur so it was smooth and about 0.5 mm in thickness. Once replaced over the wound, it should fit snugly to the linguals of not only teeth Nos. 7 and 9 but also several adjacent teeth for stability. Ideally, the stent margins expose the enamel of the support teeth at the cervical, allowing for clean adhesion of composite just above the gingiva. The Carlson Stent acts as a platform for composite application and ensures a clean field free of debris and fluids.

The stent is placed only while the PEB is being constructed. Since the design of the stent is specific in each application, its form is such that upon completion of the lamination phase or finishing phase, the stent may gingerly be removed from the lingual, leaving a small opening identified as the "irrigation port." This port can be sealed at subsequent visits if desired and patient hygiene is not of concern.

The support teeth were etched, and the unfilled resin was applied to the teeth, stent included. Seepage of fluids is rarely a problem, since the unfilled resin seals the stent-tooth interface.

A layer of "substructure" composite was laminated from the mesial of tooth No. 9, filling the old restoration defect, to the mesial of tooth No. 7. An E-1 and porcelain filling instrument may be used to obtain a thick base and ensure composite adaptation to the enamel of the support teeth over the stent (Figure 5).

The lamination phase was next, with the application of "superstructure" composite. During this phase, various shades and characterizations may be employed to the satisfaction of the patient and doctor. Figure 6 shows the overbuilding of the free-hand "composite pontic," which shall be finished either before or after removal of the Carlson Stent.

With course and fine finishing diamonds, removal of excess composite flashings was made around the abutment teeth Nos. 7 and 9. While the Carlson Stent was still in position, contouring of pontic No. 8 was also done. After preliminary finishing, the stent was removed, and the lingual margins were rounded, smoothed, and polished. Also, during initial finishing with ultrafine diamond burs, a rubber polishing wheel and cups were used to bring composite surfaces to a smooth, finished condition, seen in Figure 7.

The occlusion and incisal guidance were easily established at this time. Care was taken not to "over finish" the PEB or press beyond the patient's physical and emotional limits of endurance. In the 2 hours during this procedure the infected tooth was removed, the endo-perio abscess was cleaned from the alveolus of tooth No. 8, the replacement prosthesis was constructed in situ, and the direct composite bridge was finished. One must not minimize the challenge to the patient during this procedure. The interim finish is seen in Figure 7.

The patient is instructed in the care and maintenance of the PEB before and after the initial placement appointment, and again at the final finishing appointment about 2 to 8 weeks later. Due to remodeling of the alveolar bone taking place over 2 to 8 weeks, a greater space will develop between the gingival side of the PEB than already exists, due to the stent's thickness (Figure 7).

Figure 8 shows the gingival remodeling about 2 weeks after the PEB procedure. Bone loss will vary in each case and so will the amount of tissue reconfiguration.

In some instances, the initially placed PEB needs no post-treatment augmentation in the infra-pontic area. However, this is quite rare. In this case, there was approximately a 2-mm defect at this time (Figure 8), which was easily closed with the addition of composite at the gingival margin of the PEB, after cleaning and treatment with coupling agents.

Once composite was added, cured, and finished, the patient was instructed on cleaning with floss-threaders. At this time the patient was given these specific instructions, since doing this at an earlier stage would possibly have interfered with wound healing. The final, finished PEB is seen in Figure 9; results are quite acceptable, rivaling traditional methods.

Three months after the initial post-treatment augmentation with composite was done, addition of composite may again be necessary due to further remodeling of bone and gingiva. However, a slight space at the gum line is welcome for hygiene purposes, if it does not interfere with aesthetic considerations.

The simplicity and beauty of this approach as an alter-

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Figure 5. After etching Nos. 7 and 9 and applying clear resin adhesive, the substructure composite is laminated from Nos. 7 to 9 and cured thoroughly.

Figure 6. Specific and multiple laminations of substructure and superstructure composites are made to lingual and proximal-facial surfaces of Nos. 7 and 9.

Figure 7. The CS is removed and the pontic and attachments are shaped, shaved, contoured, and polished with a series of coarse to fine diamonds. Polishing is done with cocoa butter and Berlew Sulci Wheels (Jelenko Dental Health Products).

Figure 8. About two weeks after Carlson Bridge fabrication the infra-pontic area is cleaned, shaped, etched, silanized, and retrofilled with superstructure glossy composites of appropriate shade.

Figure 9. The finished PEB, or Carlson Bridge, may be changed at any time in the future with the addition of composites. Repairs or refurbishment years later can be done easily in situ. As an alternative approach, the direct composite bridge offers many advantages to both patient and doctor.

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native to implant procedures, traditional crown and bridge methods, or removable prosthetics is evident.

BRIDGE LONGEVITY

Our research in Honolulu since 1989 by the Carlson Dental Research Clinic has included the PEB (in situ PEB), or what we term the Immediate Carlson Bridge to simplify terminology and to honor the inventor. In more than 250 direct composite bridges done at this dental clinic research facility by Dr. Ronald S. Carlson, all have been done without the use of fiber reinforcement. In this sample of more than 250 bridges completed in this manner, almost all are functioning at this time. A sample of about one third of the 250 bridges (85 bridges, or 34% of 250) done to date over a 12-year period showed the following: 6 (7%) of the bridges had to be removed for either mechanical defects or tissue failures; 36 (42%) of the bridges were done in the time frame of 2001 to 2005 and are fully functional; 27 (32%) of the bridges are fully functional after 4 to 7.5 years; and 16 (19%) are fully functional after more than 9.5 years.

Although fiber reinforcement is theoretically a "good idea" for direct composite bridges, independent experience through the research and development team since 1989 indicates that it is unnecessary. In fact, as expressed by Rudo and Karbhari, "…Some of the various toughening mechanisms may include fiber debonding and subsequent pullout," and, "…this cracking causes the failure of the bond between the fiber and the surrounding matrix (composite)."[11] Rudo and Karbhari admit, "The matrix (composite) cracking is one of initiation rather than actual failure of the composite system. The mode of fiber bridging acts as a toughening mechanism in which the crack permeates through the brittle matrix (composite) but leaves the fibers intact."[11] From a structural point of view, intact fibers in a broken bridge do not make a successful prosthesis.

CONCLUSION

In the course of one's professional career dentists may be faced with situations in which an irreversibly damaged anterior tooth, or multiple anterior or bicuspid teeth, must be extracted due to infection, pain, or injury. Alternatives in treatment abound, but a simplistic and powerful alternative has eluded us until now.

In this article an innovative method has been presented that is not only noninvasive relative to the existing support teeth in a bridging situation, but avoids waste and uses materials efficiently and effectively. The Immediate Carlson Bridge is just that, an in situ replacement at the same time of extraction.

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Disclosure: Dr. Carlson is the inventor of the Carlson Biologic Bridge, a noninvasive approach to replacing missing teeth, with patents issued in November 1999 and October 2001.

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