Preformed Design Bridging Concept: A Case Report

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INTRODUCTION

A Brief History of Crown and Bridge Materials and Techniques

In the early days of dental history, the art of dental fixed bridges first began with a simple gold wire wrapped about one support tooth to another with a dead tooth in between. By the 1800s the process evolved to gold "swedged" shell crowns over teeth, without reduction, and a false tooth attached in between. In the early 20th century, in about 1907, as a result of Dr. Taggart's lost wax technique and the electric dental drill, the art of tooth contouring and the cast gold bridge came about.

This method of tooth contouring presented at first with the very minimal preparation of tooth structure and its replacement with a cast gold cover, the cast gold restoration. A number of journal articles during this time, however, reported on this process of tooth preparation, often condemning it as "tooth mutilation." In 1921's *The Dental Cosmos: A Monthly Record of Dental Science, Volume 61*, Dr. Marcus L. Ward,[1] a paragon of pedagogy in his time, admonished his colleagues: "I cannot but sound a warning against any practice that necessitates the misguided mutilation of sound teeth."

The precious PFM, known as the *Ceramco*, was in its infancy by the early 1970s. PFM crowns required extensive tooth reduction in the quest of a natural look. Thickness between the metal core and the porcelain was a critical factor affecting the aesthetics.

Today, in the tradition of the Ceramco, the norm is major reduction of all surfaces of the tooth structure preparatory to bridging, about 1.5 to 2.0 mm or more. In the 1960s, when "gold was king," gold was used to structure our attachments, crowns with about 0.5 to 1.0 mm reduction, and Steel's Flat Back Facings of porcelain for the pontic facings.

The porcelain jacket crown was used early in the 1930s until the 1990s, and then fell out of use with the advent of the PFM crowns. As of this writing, there are many newer materials available to the profession, allowing for the option to avoid metals altogether. However, tooth reduction, at varying amounts depending upon the material, still persists.

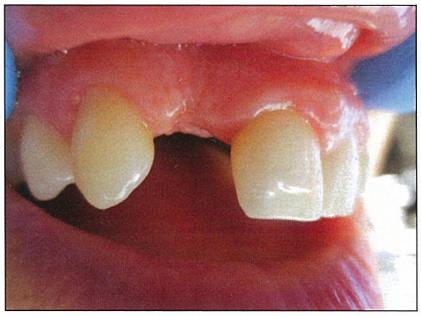

Figure 1. Missing lateral incisor No. 7 was due to a failed root canal. Both central incisior and cuspid were untouched and in good health.

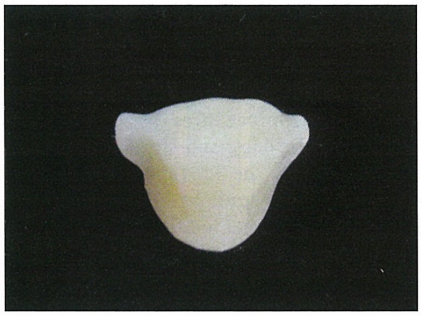

Figure 2. Prefabricated incisor composite "winged pontic" facial aspect before adjustment (Carlson Bridge Winged Pontic [WP] Tooth Replacement System [Carlson Bridge Technologies]).

Figure 3. Adjusted WP was passively set into the edentulous space prior to the attachment phase, ensuring proper positioning and fit.

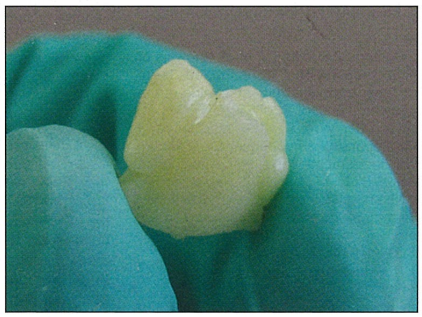

Figure 4. WP with soft attachment composite on proximal surfaces, after the addition of Carlton Bridge WP Bond Enhancer [Carlson Bridge Technologies] and resin to the WP body.

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Although fixed bridging has evolved as an art and science, it still relies on tooth reduction and potential pulp-dentine complex injury. It is well known that endodontic therapy is on the rise due to these aggressive preparations.

Emergence of Composite Resins in New Roles

The early 1980s and 1990s saw the dramatic increase in the development and use of light-cured composite resins (polymethyl methacrylate [PMMA] filled with silica or zirconium) in places heretofore unacceptable in the profession. Along with these material and technique changes, *minimally invasive dentistry* became a buzz phrase for many who would avoid tooth preparations deep into dentin (at least as much as possible).

However, the mantra today is *biomimetic dentistry*. Biomimetics is known as "the study of the structure and function of biological systems as models for the design and engineering of materials and machines." For example, composite is composed of (1) a carbon chain polymer (PMMA) moiety structured much like polymer carbon chains of collagen or the protein rod substance holding enamel rods together (interrod substance, amelogenin); and (2) the silica moiety within composite could loosely

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be analogized to the mineral enamel rods held within the rod substance sheath. Ergo, we have silica within PMMA (composite) as developed by human research. And, enamel rods within amelogenin (human enamel) as developed by nature.

Current Concerns Related to More Invasive Restorative Procedures

Dr. Gordon Christensen, well known to *Dentistry Today* readers, reported his concern regarding pulpal death due to over-reduction of teeth in his *Clinical Research Associates Newsletter* of 1995.[2] At that time, he mentioned computer data that demonstrated a close and "significant" correlation of deep crown preparations and resultant need for endodontic therapy. Much research has been done since then on the ill effects and outcomes of high-speed cutting on dentine. This can be observed in our daily experiences as dental practitioners.

In 2005, Dr. Christensen[3] published an article "How to Kill A Tooth" that again alerted the profession to the dangers of radical misguided tooth reduction. Other authors have also voiced their cautionary papers on the subject, as did those of the early 20th century.

The systematic and simple replacement of missing teeth without radical manipulation of existing sound structure, utilizing scaffolding—or a matrix—of prefabricated material may correctly be characterized as *biosynthetic tissue engineering.* A whole new conversation about the direction of dentistry for the 21st century is offered in Stephan C. Bayne's review[4] of the state of the art for restorative biomaterials titled, *Dental Biomaterials: Where Are We and Where Are We Going?*

Introduction of Fiber-Reinforced Composite Resin Techniques

The art of preparing for bridges utilizing minimal tooth reduction had seen very little advancement until denture teeth were first used with fiber-reinforced composites.[5] Various clinicians around the early 1990s began to use glass fibers, Kevlar fibers, or other polyethylene fibers as a means of adhering the denture tooth to the natural abutments. Now, most major suppliers of dental composites offer their own brand of fiber reinforcement material. Dr. Howard Strassler, University of Maryland,

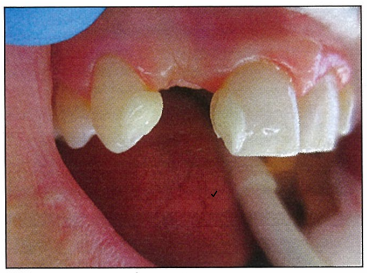

Figure 5. After etching, rinsing, and drying the proximal attachment surfaces of the support teeth, composite resin was applied for the attachment phase.

Figure 6. At the attachment phase, the WP was gingerly inserted into the space according to its previously determined line-of-draw.

Figure 7. Soft composite was then gently layered over the WP, both the facial and lingual aspects of support teeth, and light cured.

Figure 8. Preliminary sculpting was accomplished with medium-to-fine flame diamonds and rubber wheels after the occlusion was adjusted.

Figure 9. Final restoration after finishing and polishing to a high gloss.

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advocates Ribbond fiber attached to a lingual groove carved into a laboratory-fabricated composite pontic made on a plaster model of the missing tooth. He demonstrates the complicated and, in the author's opinion, presently outmoded build-up process for simply a one-tooth replacement. (One may view this technique at youtube.com/watch?v=qJDvw7wIdeE.)

The use of macrofiber reinforcement for these purposes is optional since its capacity to strengthen the bridge is contentious at best.[5-11] Another common objection to fiber reinforcement methodology is that it is technique sensitive. One must meticulously pay attention to imbedding all fiber portions within the overlying composite while not leaving any exposed fiber. We at Carlson Bridge Technologies find this method unnecessary, bulky, very time-consuming and, in addition, this technique potentially weakens the bridge rather than strengthening it. Our testing, in concert with with Knight and Whittaker's,[10] reported a 10% to 15% weakening effect; while van Heumen et al[12] stated the strengthening is equivocal.[3] At best, nobody really knows!

Pure acrylic denture teeth made of PMMA will not bond or polymerize with composites. Success was dependent on mechanical factors alone and not any chemical bonding factors. The surface interface of the PMMA denture tooth and the composite material used to bond the pontic to the support teeth was the weakest link; actually, there was no link at all, since there was nothing to bond to—that is, without silica within the PMMA, there is no covalent bond. We now have PMMA denture teeth that reportedly incorporate nanohybrid composite, but we find that these denture teeth still will not bond to conventional composites either.

Introducing the "Winged Pontic" Prefabricated Bridge

There is a very small population of dentists, which is growing in numbers, who are avoiding traditional radical tooth reduction for fixed bridges or who would like to offer an alternative method of tooth replacement for their patients. The art of bridging, or other restorative procedures, for this fraction of biodentists is moving in this direction. The recent introduction of the Componeer (Coltene) prefabricated laminate system underscores this phenomenon. Other companies are following this innovation of prefabricated laminates used in the dental office.

The system of composite tooth replacement, introduced by Carlson Bridge Technologies in 1989, was designed to avoid the cumbersome and ineffectual use of fibers. Although macrofiber reinforcement appears as though it would strengthen attachments and composite itself, much like metal rods in concrete, results vary and are equivocal. Again, remember that the studies cited previously have shown that macrofibers weakened the composite matrix by about 10% to 15%.

Prior to this innovation, the art of bridging was a slow and methodical lamination of the pontic and then sculpting it as desired. The new *Preformed Design Bridging,* presented as the prefabricated Carlson Bridge Winged Pontic (WP) Tooth Replacement System (Carlson Bridge Technologies), consists of preformed composite tooth forms that are first adjusted to fit the space of the missing tooth or teeth. Once adjusted to the space, the composite is added to the natural attachment teeth (in lieu of prepped abutment teeth) and the appropriate surfaces of the pontic, and then gingerly set into the space at the doctor's discretion and preference. The excess material is smoothed onto the abutment teeth and the pontic and then the restoration is bonded in place. Successive layers of finishing composite are added for strength and aesthetics. Following this phase, the sculpting is employed to craft a high-quality custom prefabricated and directly placed composite resin bridge.

CASE REPORT

A 47-year-old female presented to our office unable to afford a comprehensive treatment plan. As a solution to replace her missing upper lateral incisor (tooth No. 7) (Figure 1) and to restore her smile, she chose the prefabricated WP option over a removable appliance ("flipper").

Clinical Protocol

The prefab WP (Figure 2) would be trimmed and adjusted into the space of the missing lateral incisor between teeth Nos. 6 and 8, without attachment composite affixed (Figure 3). First, for eventual ease of proper placement, the line-of-draw was determined and the WP adjusted accordingly. Then, the WP was etched for 30 seconds, cleaned with water, and a clear resin bond enhancer applied (Carlson Bridge WP Bond Enhancer). Next, composite resin (Carlson Bridge WP clear resin adhesive) was applied to the proximal surfaces of the WP (Figure 4) to be ready for insertion and attachment only after the next steps were completed. The proximal enamel of the support teeth (Nos. 6 and 8) was acid-etched, rinsed, and air-dried. Next, after applying a clear bonding resin (Carlson Bridge WP clear resin adhesive), composite resin material was applied to the proximal surfaces of the support teeth (Figure 5). The prefabricated, pretreated WP was carried to the space and inserted (Figures 6 and 7) using the predetermined line-of-draw. The attachment composite was smoothed over all aspects of the pontic and support teeth and then light cured.

The WP was layered over with the practitioner's choice of finishing composite using artistic/creative skills to mimic the patient's natural aesthetics. (Other than the "attachment composite" used in the substructure, which can also be used as a "finishing composite," the over-structure or final finishing composite may be brands such as Gradia, Grandio, Ultradent Products, or other similar composite resins used by the practitioner in his or her practice.) Once light cured (TPC LED55 440nM-490nM [TPC Advanced Technology]), the occlusion was checked and adjusted in all excursions. Next, preliminary sculpting was accomplished with medium/fine flame diamonds and rubber wheels. Final characterization can be done with appropriate burs and then the restoration completed (Figures 8 and 9) using the clinician's favorite composite resin finishing and polishing kit (25-µm and 50-µm flamed-shaped finishing diamonds [Lasco Diamonds] and Dedeco "white flexies" rubber wheels [Dedeco International] used for high-gloss results).

CLOSING COMMENTS

The WP tooth replacement system was developed to offer clinicians a choice, when indicated, for treating patients with a minimally invasive approach to bridge design. Biosynthetic tissue engineering[11] seems to be the leading edge in dentistry today, but only as an adjunct to other technical procedures carried out in the dental office, such as implants, flippers, or traditional porcelain veneer bridges, or the recently introduced directly placed prefabricated Componeers.

This technique allows for a pleasant experience for the patient who can come away with an immediate dental cosmetic enhancement, spending a minimal amount of time in the dental chair. Additionally, it will not create a financial burden or require extensive healing time or unnecessary oral discomfort. In addition, it is also beneficial to the clinician since the procedure is shorter in duration, and therefore, less physically demanding, less complicated in that intricate tooth preparations are unnecessary, and more rewarding creatively, artistically, and remuneratively.✦

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Disclosure: Dr. Carlson is engaged in the research and development of advanced dental composites and their application in various clinical circumstances for Carlson Bridge Technologies, Inc. However, other than being an employed contractor with Carlson Bridge Technologies, he holds no ownership interests, position, or control in the company.