The Hybrid Bridge-Zirconia Framework Bonding and Veneer Placement for a Congenitally Missing Lateral

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ABSTRACT
The dental profession continues to advance in cosmetic tooth replacements that are highly esthetic, strong and conservative. Zirconia has proven to ba an excellent choice in esthetic/restorative dentistr because of its high strength and non-metallic color. The hybrid bridge is a combination of a bonded zirconia framework and a traditional porcelain veneer. In this case a conservative bonded framework and 4 veneers were done to replace a congenitally missing incisor and to make smile enhancements.

The combination of strength and esthetics is at an all-time high in dentistry. Recent dental advancements have expanded clinician choices for tooth replacement with implants, full contour esthetic bridges, bonded conservative bridges, and a variety of removable prostheses that can all be highly esthetic options for tooth replacement.[1]

The "hybrid bridge" is a highly esthetic tooth replacement option featuring a zirconium oxide framework that is placed onto abutment teeth first, and then covered with a traditional porcelain veneer. It has the advantages of having no metal to hide and no visible bridge connectors that can be an esthetic detriment for many bridges. The preparations are simple and the final cosmetic appearance can be excellent.

Long lasting success is derived from a union of proper materials, effective tooth preparation, functional prosthesis design, dependable bonding, biologically acceptable soft-tissue treatment, tolerated occlusion, and accurate communication between the patient, dentist, and lab.[2] All of these factors contribute to the ultimate long term success or failure of a restoration.[3]

ZIRCONIA AS A CONSERVATIVE BRIDGE FRAMEWORK

There have been many non-metallic framework bridge substrates including lithium disilicate, aluminous porcelain, and zirconia all of which can provide an adequate level of esthetics.[4] Minimally invasive fixed bridges for anterior tooth replacement have proven to be very successful particularly if retentive preparations are done, if there is a defined path of insertion, and if connectors are of adequate thickness and height.[5] Each of these materials can provide ample strength for tooth replacement if used in the proper situation.[6,7]

Zirconium oxides have been widely used the last few years as a bridge framework because of its non-metallic color, fracture resistance with flexural tests over 1000MPa, and excellent long term clinical success.[8] With bridges the long term success is increased if the zirconia connectors have a minimum height and thickness of 3mm; this provides ample strength to withstand most masticatory forces.[9]

Monolithic zirconia restorations have become very popular in the posterior but less than ideal esthetics often warrant veneering

FIGURE 1—A teenage female wanted conservative replacement for a congenitally missing lateral incisor.

FIGURE 2—Smile analysis revealed a canted and incorrect midline, uneven incisal edges of the centrals, excessive gum tissue showing on the laterals.

FIGURE 3—A composite tooth had been formed and bonded in place after orthodontics to preserve tooth space and gingival contours.

with a more esthetic porcelain when excellent cosmetic results are needed.[10,11] This relatively weak bond between this layering porcelain and the zirconia is the "weak link" in this process with this bond having more than five times less flexural strength than the zirconia itself.[12,13]

Although full zirconia bridges can be cemented, more conservative restorations should be bonded in place to increase the chance of long-term success. Zirconia (ZrO_2) is a silica-free, acid resistant, polycrystalline ceramic that does not contain amorphous silica (SiO_2) making it ineffective to traditional glass etching treatments such as hydrofluoric acid (HFl) followed by silane.[14,15] Bonding of zirconium based restorations cannot be done with the same methods of traditional glass-porcelain.[16,17] Research shows that bond strengths using methods including sand blasting with aluminum oxide, silane treatment, or other chemicals provided a weak bond at best.[18-21]

BONDING WITH A ZIRCONIA FRAMEWORK HYBRID BRIDGE

A hybrid bridge has a zirconia framework placed on the lingual of the conservatively prepared teeth and a traditional porcelain veneer bonded to the facial aspect of this structure. Adhesion along with proper abutment preparation and occlusion must be factored into planning for long term success as with any conservative anterior bridge.[22,23]

There are two bonds that must be successful with this bridge; the zirconia to the teeth and then the porcelain to the zirconia. Maximizing the bond strength with bridge design and with bonding techniques could be a large advantage with bridges of less aggressive preparation.[24,25] A primer to increase the bond strength of the zirconia to the tooth and the porcelain to the zirconia is a great benefit traditional retention/resistance form is lacking.[26,27] Phosphate monomers form the basis for chemical bonds between the zirconia and the primer allowing for a cohesive bond to the resin cement.[28,29]

A zirconia primer has been developed (Z-Prime, Bisco) that has been shown to significantly increase this bond strength. It is a single step liquid that is dropped onto the zirconia before bonding to the tooth and before placement of the overlaying porcelain. Dual cure resin cements such as BisCem (Bisco, Shaumberg, IL), Maxcem (Kerr, Orange, CA), and RelyX Unicem (3M ESPE, St. Paul, MN) can be successfully used to bond the substructure to the tooth insuring polymerization without relying on light transmission through the zirconia. Traditional light cure resin can be used to bond the porcelain to the zirconia such as Choice 2 (Bisco), Variolink (Ivoclar), or Insure (Cosmedent) and are used with a dentin bonding agent (DBA).

PULL QUOTE

TREATMENT PLANNING: VENEERS AND THE HYBRID BRIDGE PREPARATION

A 15-year-old female 14 months after orthodontic treatment came to the office for replacement of tooth #10 (Fig. 1). She also had a

FIGURE 4—Plans included grafting and implant and other conservative fixed prosthetics, a hybrid bridge was chosen to avoid grafting and other less-esthetic options. Tooth #7 had composite bonding to hold space during orthodontics and the plan included porcelain veneers on the 3 incisors.

FIGURE 5—Before any tooth modifications, several shade images are taken for lab use.

FIGURE 6—After removal of the temporary, an indelible marker was used to mark desired soft tissue changes with respect to biologic width.

FIGURE 7—A diode laser on low wattage was used to enhance gingival contours and to develop the pontic site. The lab would be instructed to smooth and recontour the socket as needed to provide an "ideal" ovate emergence profile.

FIGURE 8—After conservative tooth preparation a retraction paste was placed before PVS impression taking.

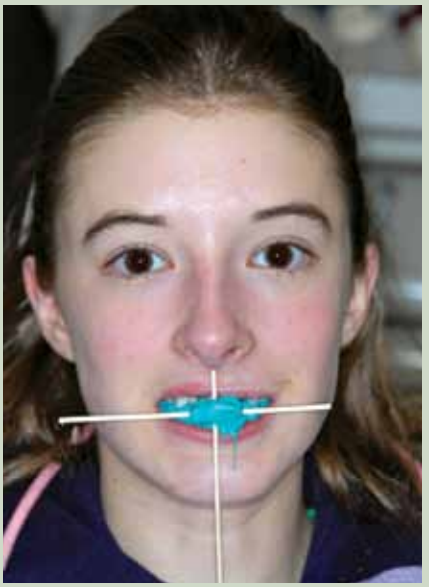

FIGURE 9—All models, impression, photos and bite registration with alignment guide were sent to the lab.

FIGURE 10—The abutments were prepped on the lingual with a 330 bur giving 1.5mm minimal zirconia thickness, 3mm high, and 5+mm width. Boxes were placed interproximally allowing only one path of insertion.

FIGURE 11—The framework of the hybrid bridge is milled zirconia in a color that approximates the preparation shade of the natural teeth. The pontic shape mimics a lateral prepared for a veneer.

FIGURE 12—The zirconia substructure is independent of the veneering porcelain and fills the majority of the pontic socket.

FIGURE 13—Pressed porcelain with layering and characterization is done to replicate a youthful dentition.

FIGURE 14—After retraction cord is placed and fit verified, the preps are etched and DBA placed. The primed zirconia is bonded into place with a dual cure composite luting material. No curing yet.

FIGURE 15—Clean up is quickly done removing most of the dual cure cement on the facial aspect of the pontic. Care must be taken to hold the bridge framework in place while seating the veneer.

peg lateral for #7, excessive gum tissue showing in both lateral positions, uneven central incisor edges, and a canted midline (Fig. 2). Space had been opened during orthodontic treatment and a composite tooth temporarily bonded into place to hold the space (Fig. 3).

An implant, a retainer with an acrylic tooth, a transitional partial, a traditional fixed bridge, and other options were considered. Because of her age and the will of her parents to minimally prepare the teeth, a conservative hybrid bridge was chosen for replacement of #10 (Fig. 4). Porcelain veneers were also planned to replace the composite on the other lateral and to even the color and shape of the central incisors. A full series of photos was taken before any preparation and included several images for lab shade communication (Fig. 5).

SOFT TISSUE PREPARATION

Lasers are an important part of current esthetic dentistry and if done with respect to periodontal tissues and biologic width, results can be a great enhancement to cosmetic treatment.[30,31] The 810nm soft tissue laser offers excellent control of tissue sculpting with very predictable healing and tissue tolerance.[32] Ease of use must not tempt the clinician to disregard sound biologic principles.[33]

After local anesthesia, periodontal measurements were done with respect to biologic width and desired soft tissue changes marked with an indelible pencil.[34] These desired "ideal" marks will be modified according to biologic principles with restoration margins kept 2.5-3mm from the boney crest[35] (Fig. 6). These principles must be followed to prevent possible chronic periodontal inflammation and unwanted gingival responses such as redness, bleeding, and irritation.[36,37] A diode laser, Odyssey (Ivolcar Vivadent, Amherst, NY) was used to shape soft tissue and to develop the pontic site further to a depth of about 3mm at the apex of the ovate socket (Fig. 7). The lab would be instructed to smooth and "idealize" the pontic site as needed so that slight soft tissue pressure would be present at insertion.

TOOTH PREPARATION

The lingual preparations of #9 and #11 were done first with a 330 bur to a depth of 1.5mm and

FIGURE 16—The veneers are being placed with a light cure composite luting material before any curing has taken place. After clean up, light curing is done.

FIGURE 17—Follow up at 18 months showed excellent tissue response in the pontic area and good functional acceptance.

FIGURE 18—The enhanced cosmetic result is noted and long term success should be expected with a natural emergence profile and good tissue response.

FIGURE 19—The evidence of patient acceptance is obvious and further advances in esthetic tooth replacement should be available when the bridge needs replacing years in the future.

FIGURE 20—Restorations blend in well with the natural dentition and the hybrid bridge reduces the un-natural look of the connectors often seen with traditional bridges.

FIGURE 21—Acceptable esthetic result.

interproximal boxes were placed allowing a 3mm height and width of the framework connectors. A finish diamond used to make interproximal areas of teeth #9 and #11 flat and parallel with each other (Fig. 10). The boxes and interproximal areas provided a single path of insertion for the zirconia substructure.

The old composite was removed and the incisors prepped minimally using the same finishing diamond (#859-010-10 Diatech, SC), staying in enamel in almost all places. The midline was prepared towards the lingual so that the ceramist would have room to correct the midline and cant. Finish lines were placed about a half mm subgingival after final laser recontouring.

A retraction paste (ExpaSyl, Kerr), was placed into the sulcus and pontic area and allowed to sit for five minutes, rinsed, scrubbed with a microbrush and peroxide, and rinsed again (Fig. 8). Two polyvinyl impressions were taken along with a bite registration, alignment guide, opposing alginate, and shade verification images (Fig. 9). These were all sent to the lab along with a full series of pre-operative images. Composite temporaries were made to maintain soft tissue alterations.

RESTORATION FABRICATION AND PLACEMENT

The lab was instructed to enhance the pontic site slightly as needed to provide a 100% ovate design with proper emergence profiles (Fig. 10). A zirconium substructure, (Lava, 3M, Minneapolis, MN) was designed to fill most of the pontic socket and with a facial shape to mimic a tooth prepared for a porcelain veneer (Fig. 11). The zirconia framework was made in a hue and value that was similar to the prepared teeth, in this case A1, to help provide consistency in color and value despite the differing underlying materials (Fig. 12).

Pressed veneers, (Authentic, Jensen Dental, North Haven, CT) were made, cut back, layered, and customized according to our written prescription with moderate translucency and areas of white to mimic a youthful appearance. Verification of fit and contour was made on the models (Fig. 13).

After temporary removal, teeth were pumiced, retraction

cord placed, and all restorations tried in with water for color verification. All restorations were then cleaned with alcohol and silanated. The zirconia primer (Z-Prime Plus, Bisco) was placed on the zirconia framework, air thinned, and followed by several coats of a dual cure DBA (All Bond-3, Bisco). The internal veneer surfaces were cleaned and bonded in the same way.

All preparations were etched with 37% phosphoric acid for 15 seconds, rinsed thoroughly, and left moist. Several coats of the same DBA were placed and air thinned. A dual cure composite luting material, (BisCem, Bisco), was placed directly into the abutment preparations and the zirconia seated (Figs. 14-15). Excess material was quickly cleaned up and before curing, the veneers were luted into place using a translucent light cure composite material (Choice 2, Bisco) (Fig. 16). Care was taken to secure the bridge framework from the lingual as the veneer for #10 was placed. Clean up was completed with a 204s scaler, explorer, #12 Bard Parker blade, and floss. Light curing was then done for 30 seconds per tooth.

FOLLOW UP AND EVALUATION

At 18 months the patient response is excellent with very good esthetics and acceptable soft tissue response (Fig. 17). The natural emergence profile from the pontic has been maintained and soft tissue response has been adequate (Fig. 18 She was happy with the cosmetic result and reported wearing her retainer/bruxism splint nightly.

The hybrid bridge is a worthy prosthetic choice in cases where high esthetics and the desire to be conservative are in demand (Figs. 19-20). One of the primary concerns of every dentist is the conservation of tooth structure while providing long lasting function. In this day of "heightened cosmetic awareness" the quest for metal free restorations continues and conservative metal free bridges are in demand. With improving bonding techniques and esthetic materials conservative anterior bridges should be considered in many partially edentulous cases (Fig. 21). **OH**

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Oral Health welcomes this original article.

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