Clinical indications for a composite-metal PFM restorative

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A lthough "metal free" has been a goal in extraoral dentistry, the need for subgingival margin placement, masking of discolored tooth structure, or the necessity for conventional prosthodontics to contraindicate the use of these newer dental materials, the traditional porcelain-fused-to-metal restoration is called for. It has, however, fallen out of favor with many practitioners primarily because of its cosmetic shortcomings in the esthetic zone.

An alternative to conventional PPFs has proven itself as a prime option under these circumstances, both functionally and cosmetically. Captek (Argen Corp, San Diego) is a composite metal, not an alloy, whose optical properties accurately mimic those of anatomic underlying hard and soft tissues.1 In the hands of a knowledgeable ceramist, ultimate vitality can be obtained by using this system (Figs. 1, 2), and the shade matching attained with this material is remarkable (Fig. 5).

In addition, Captek has demonstrated microstructural improvements as its primary mechanism of porcelain adhesion,2 which in my experience has resulted in the superior strength and fracture resistance that is often required in specific clinical situations. The Captek system uses a unique bonding mechanism (referred to as the Universal Porcelain Coupler or UCP) between the coping material and porcelain (the composite resin) that extends gold and platinum micro-filaments from the Captek surface. These microextensions provide exceptional mechanical bond strength. This system was developed because of Captek's pure, high noble metal composition and has the advantage of not producing any oxides, a byproduct of the traditional PFM bond — which therefore requires a different method of bonding to porcelain. This Captek bonding process eliminates the conventional grey oxide layer created during adhesion with other PFM and surpasses it in its bond strength. This creates a tenacious bond between the Captek coping and porcelain to cytic loadings that exceed expected stresses.3 The elasticity of this micromechanical interlocking diminishes as it is caused by coefficient of expansion differences that often account for porcelain cracking and chipping.

The UCP on Coptek copings provides a color backdrop for the final restoration that is the closest to natural tooth structure and resembles the color of dentin nearest to the pulp. These hues of gold and yellow-orange provide the most natural color background for the porcelain as dentin has an inherently yellow-gold color with a vital pulp producing a warm red background.

Therefore, the Captek coping provides the perfect base for any type of veneering — porcelain, acrylic or composite — giving it a warmer and more organic tone. The UCP's light-scattering effect also contributes to the natural appearance of Captek crowns. Light reflecting from the coping through the porcelain is scattered by the extensions of the UCP layer, much like it is by natural tooth structure. Ceramic light is fragmented and dispersed by natural tooth structure due to its enamel prisms and dentinal tubuli just as it is by the UCP in Captek.

The Captek coping also exhibits an increased resistance to chipping that derives from its unique three-layered structure (a lattice of gold that is strengthened with palladium and platinum), which provides a high degree of elasticity and resilience (Fig. 4). Masticatory forces and everyday parafunction produce vibrations and shears that can harm porcelain and its underlying supporting structure, whether implant or natural tooth.

Unprotected porcelain may chip and crack during function. Captek protects its porcelain by absorbing masticatory and parafunctional impacts that advance from the point of contact inward. When a restored implant or natural tooth is exposed to these continuous impacts and vibrations, their structure is weakened and the periodontium can be affected. The inner and outer layers of Captek are each 25 microns thick, 97 percent gold and 3 percent silver. These layers are very forgiving and efficiently absorb the shocks and vibrations that travel through the porcelain during routine function. This extraordinary shock-absorbing feature protects the layered porcelain, and it is particularly valuable for implant cases where no periodontal ligament cushioning exists.

What's more, Captek affords an important alternative for situations of limited space, such as at the lower incisors. With its one-of-a-kind configuration, the Captek coping can be thinner than conventional metals, allowing the technician more latitude in porcelain design with conservative, minimal thickness restorations.

Even though the Captek coping is not cast, its extensively documented marginal integrity4 and antibacterial qualities5 make it an ideal restorative where subgingival margins are necessary, and I have found in many cases that these properties may afford the clinician more leeway in relation to the biologic width. The coping is made directly on the die model, providing an exceedingly precise fit.

In the Captek protocol, a metal embedded wax is applied in steps directly to a refractory die for the design and construction of the final metal coping, resulting in a highly precise marginal adaptation (Figs. 5-10). Other PFM technologies employ indirect methods that can introduce inaccuracies and distortions to marginal integrity. Captek can also be burnedish to further refine its marginal precision. The coping can be occluded before porcelain layering with different spacers to accomplish just the desired proximity to the tooth and spacing for cement thickness. Any crown and bridge cement can be used with Coptek except those that must be light cured for best results. Captek maintains its accuracy through porcelain firing thanks to its internal reinforcing skeleton that resists warpage.

Research studies have found a marginal precision after cementation of 14.5-18 microns in single crowns and bridges.6 Either chamfer or shoulder bevel designs can be integrated with margins in metal or porcelain. When considering the use of this material, he certain to use a Captek-certified laboratory in order to realize its full benefits.

These unique properties are the result of years of extensive research that started in 1972 by two Israelis, Bzhak Shoher, DMD, MS and Aharon White- man, MTC Together they have developed several different dental materials, such as RPS (reinforced porcelain system), Inoxa and the Renaissance system, which have proven to be extremely biocompatible with outstanding esthetics in everyday dental practice. In the year 1996, their research into gold, palladium and platinum metal-alloy yielded Captek, when this material was introduced to the international dental community.

In addition, during the following years, Shoher and White- man cultivated multiple improvements to the product, the most significant being Captek Nano, which was introduced in 2007. This version allows for the fabrication of longer span bridgework and adds implant supported restorations to this material's broad repertoire.

The elemental ratios have been altered in this process to reflect a composite metal content of 84 percent gold with the higher concentrations of 5.5 percent platinum and 7.2 percent palladium for even greater strength. This permits the varying coping thicknesses.
uses of 0.28 mm for longer span bridge fabrication, 0.25 mm for routine restorations and even less than 0.2 mm for areas in the esthetic zone where maximal clearance for porcelain application may be necessary.

Cepak copings for bridge work utilize a specialized soldering method that precludes the possibility of any casting distortion for a completely predictable fit. At this time, close to 10 million Cepak units have been placed in the United States alone.

Uses

It is often the case that the location of previous restorations, cemental exposure or new carious lesions will mandate the placement of subgingival margins. Cepak has been my experience that because cariogenic oral bacteria are parafunctionally aerochic, and therefore do not have a significant presence in the subgingival environment, subgingival margin placement results in less recurrent decay. Due to the moisture inherent in situations such as these, a cementable restoration is essential, and of the new generation in metal-free products, only zirconia will fill that bill.

However, zirconia is among the least esthetic of the ceramics whereas Cepak achieves clearly superior esthetic results intrinsically and, in clinical testing, is given to encourage the most natural soft tissue esthetics as well. This quality is explained by the influence of the Cepak coping’s warm metal color and its aforementioned bacteristatic properties, which contribute greatly to gingival health with color retention, even including semi-precious metal copings, can be problematic (Figs. 11, 12).

Bacteriostasis occurs due to significant metal-to-metal adhesion to Cepak as compared with other crown and inlays. Over-hydration or even natural tooth structure, and significantly reduces harmful bacteria in the gingival sulcus over time. Because Cepak is composed completely of precious metals, it will not react in this environment to cause oxide formations. This lack of oxides is a major advantage for all the Cepak copings surrounding structures from the gingivae to porcelain. Oxydes from a standard crown’s margins can infiltrate the adjacent gingiva, causing in-growth of epithelium and in some instances, an inflammatory reaction. The Cepak coping avoids this issue by infiltration in the proximate gingiva, connective tissue or alveolar bone with this regard. Oxide formation on standard crown margins can make this type of restoration difficult, causing greater plaque accumulations that can eventually lead to gingivitis and may, in severe cases, advance to periodontitis. Cepak’s oxide-free surface prevents the occurrence of such reactions.

In conventional crown systems, metals oxidize during porcelain firing, causing an overall grayish look at the margins. Over time in the oral environment, these standard metals continue to oxidize, further discoloring the marginal porcelain through dispersion of the oxide molecules. Cepak metals will not oxidize in the oral cavity under any circumstances, thus preserving the original color of the restoration. Cepak’s composite metal structure also produces a micro-circulational bipolar stimulus that seems to progressively invigorate the tissue cells around it. So gingivae are not only unaffected by Cepak, but the product produces a significant positive effect on these tissues.

Thus, there is comparatively less gingivitis and recession around a Cepak crown than found around other ceramo-metal restorations. Consequently, Cepak has become my material of choice for direct restorations in the esthetic zone that demand subgingival margins.

As any dentist knows, endodontically treated teeth often discolor significantly after such procedures. It is also true that there are some implant cases in which it is preferable to use a metal abutment, and in these instances the effect on gingival color can be decidedly negative. The transcen- dency of most metal-free restorations will not allow for the full masking of this tooth discoloration or metal reflection, and esthetic outcomes will be adversely affected when those materials are used under these circumstances.

As a PFM restoration, Cepak affords ultimate masking qualities, and its excellent esthetic results make it the prime choice in situations where masking abutment dis- coloration is of prime importance.

The longevity of large restora- tions can be a major consequence to the treating dentist. Remarks due to functional failure are rare to the dentist not only economically, but in terms of his or her reputation as well. The greater strength of PFM restorations over their metal-free counterparts, even including zirconia units, is well documented in the literature. In cases where occlusal or parafunctional pressures are of a principal concern, ceramic crowns will be the longest lasting.

Considering Cepak’s advanced ceramic capabilities and strength characteristics, there is no disadvantage to using it in restorations in a smile design case that has wear issues, which could lead to potential failures if all ceramics are used. It is on this last point that I am met with the most skepticism from colleagues in my lectures around the country. There are many practitioners who simply will not believe that a PFM restoration can match the vitality of an all-ceramic product.

I have found in my practi- cal experience that all other things being equal (skill of the laboratory technician involved, quality of the clinical records provided, etc.), it is easier to fabricate a reliable lifelike restoration from a metal-free material, but in the hands of a master ceramist, Cepak is an organic realist that is virtu- ally indistinguishable from nature in Figs. 13, 14.

In fact, complex restorative cases blending Cepak and all-ceramic units have been documented to realize a harmonious result.10

Conclusion

Although all-ceramic restora- tions have been en vogue when it comes to transformational restorative cases in the esthetic zone for some time – even being taught as state-of-the-art in dental schools – they are not the be-all or end-all when it comes to solving some common clinical situations.

The placement of all-ceramic restorations is much more technique sensitive than its ceramic-metal counterpart, and their long-term function, especially when all occlusal considerations have not been carefully accounted for, is questionable at best in comparison.

There is a porcelain-fused-to-metal alternative that is stronger than the all-ceramic choices available, kinder to gingival tissues, more esthetic when machined through these tissue and every bit as natural looking when fabricated by a talented ceramist. These attributes come from the design of Cepak’s unique composite metal coping (Fig. 15),16 whose properties set it apart from all other PFM’s in the 10 years that I have been using it.

If there are cases for which you hesitate to use a metal-free restorative due to occlusal questions or where periodontal, abutment color or gingival factors are paramount, consider Cepak. It will perform flawlessly under all these conditions while delivering cosmetic results that are unimprovable by any other material when in the hands of a gifted laboratory technician. What more could you ask for?

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Editorial note: A complete list of references is available from the publisher.

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