Clinical indications for a composite-metal PFM restorative

By Barry F. McArdle, DMD

Although “metal free” has been the mantra in some dental circles, even when it comes to indirect restorations, all-ceramics have their limitations. When parafunctional habits, wear of the existing dentition, the need for subgingival margin placement, masking of discolored tooth structure or the necessity of conventional cementability 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 PFM restorations is the use of composites, both functionally and cosmetically. Captek (Argen Corp, San Diego) is a composite metal, not an alloy, whose optical properties accurately mimic those of enamel’s underlying hard and soft tissues.

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 micromechanical interlock as its primary mechanism of porcelain adhesion, 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 porcelainte composite resin) that extends gold and platinum micro-fillaments from the surface. These micro extensions 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’s and surmounts it in its bond strength. This creates a tenacious bond between the Captek coping and porcelain to the preparation’s resin.1 The elasticity of this micromechanical interlocking diminishes as caused by coefficient of expansion differences that often account for porcelain cracking and chipping.

The UCP on Captek 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—to give 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. Serrated light and fragmented by dispersed by natural tooth structure due to its enamel prisms and dentinal tubuli just as it is by the UCP in Captek.

The Coping capex also exhibits an increased resistance to any type of veneering—porcelain, acrylic or composite, which 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. 6). Masticatory forces and everyday parafunction produce vibration and shear that cause the layered porcelain to underly 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 re-implantation 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 Coping capex can be thinner than conventional metal, allowing the technician more latitude in the porcelain design with conservative minimal thickness restorations.

Even though the Captek coping is not cast, its extensively documented marginal integrity and antibacterial qualities 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 burnished to further refine its marginal precision. The coping can be welded 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 Captek except those that must be light cured for best results. Captek maintains its accuracy through porcelain firing thanks to its internal re-inforcing skeleton that resists warpage.

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

The unique properties are the result of years of extensive research that started in 1972 by two Israelis, Itzhak Shohet, 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 proved to be extremely biocompatible with outstanding esthetics in every day 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, Shohet 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 higher concentrations of 5.5 percent platinum and 7.2 percent palladium for even greater strength. This permits the varying coping thicknesses.
es of 0.28 mm for longer span bridge fabrication, 0.23 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.

CapekCopings for bridge work utilize a specialized slurry method that precludes the possibility of any casting distortion for a completely parameter free fit. At this time, close to 20 million Capek units have been placed in the United States alone.

Uses

It is often the case that the location of previous restorations, cementation exposure or new carious lesions will mandate the placement of subgingival margins. It has been my experience that because cariogenic oral bacteria are primarily anaerobic, 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 generations in metal-free products, only zirconia will fill that bill.

However, zirconia is among the least esthetic of the ceramics whereas CapekCopings achieve clearly superior esthetic results intrinsically and, in clinical testing, is even called to encourage the most natural soft tissue esthetics as well.

This quality is explained by the influence of the CapekCopings warm metal color and its aforementioned bateriostatic properties, which contribute greatly to gingival health. The only other material, even including semi-precious metal copings, can be problematic (Figs. 11, 12).

Bacteriostasis occurs due to significant interfacial adhesion to CapekCopings as compared with other crown and inlay/resin systems, even in natural tooth structure, and significantly reduces harmful bacteria even in the gingival sulcus over time. Because CapekCopings is composed completely of precious metals, it will not react in the gingival environment to cause oxygen formation. This lack of oxides is a major advantage for all the CapekCopings surrounding struc- tures from the gingival to periodontal. Oxides from a standard crown's margins can irritate the adjacent gingiva, causing inflammation and in some instances, even an inflammatory reaction. The CapekCopings margin and interfacial adhesion in the proximate gingiva, connective tissue or alveolar bone are not necessary.

Oxide formation on standard crown margins can make the gingiva appear necrotic, cause greater plaque accumulations that can eventually lead to gingivitis and, in severe cases, advance to periodontitis. Capek's oxide-free surface prevents the occurrence of such reactions.

In conventional crown systems, metals oxidize during porcelaining, causing an overall grayish look at the gingival margins. Overall, in the oral environment, this standard metals continue to oxi- dialize, further discoloring the marginal porcelain through dispersion of the oxide molecules. CapekCopings will not oxidize in the oral cavity under any circumstances, thus preserving the original color of the restoration. CapekCopings' composite metal structure also produces a micro-electro- bipolar stimulus that seems to progressively invigorate the tissue cells around it.  

Gingivae are not only unaffected by CapekCopings, but the products also have a positive biocompatible effect on these tissues. Thus, there is comparatively less gingivitis and recession around a CapekCopings crown than found around other ceramic-metal restorations. Consequently, CapekCopings' margin and interfacial adhesion 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 where it is preferable to use a metal abutment, and in these instances the effect on gingival color can be decidedly negative.  

The transpar- ency of most metal-free restorations will not allow for the full masking of this tooth discoloration or metal reflection, and cosmetic outcomes will be adversely affected when those materials are used under these circumstances.  

As a PFM restoration, CapekCopings afford 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 is a major conse- quence to the treating dentist. Remakes due to functional failure are easy 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 litera- ture. In cases where occlusal or parafunctional matters are of a principal concern, cer- amometal crowns will be the longest lasting.

Considering CapekCopings' advanced bateriostatic, esthetic, and strength characteristics, there is no disadvantage to using such restorations in a smile design case that has wear issues, which could lead to potential failure of all-ceramics are used. It is on this last point that I am met with the most skepticism from col- leagues during 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 metal-free restoration in a very life-like restoration from a metal-free material, but in the hands of a master ceramist, CapekCopings can produce an organic realism that is virtu- ally indistinguishable from nature (Figs. 13, 14).  

In fact, complex restorative cases blending CapekCopings and all-ceramic units have been documented to realize a har- monious result.

Conclusion

Although all-ceramic resto- rations have been en vogue when it comes to transforma- tion of 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 solv- ing many 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 com- parison.

There is a porcelain-fused- to-metal alternative that is stronger than all ceramic materials available, kinder to gingival tissues, more esthetic when compared to these tissues and every bit as natural looking when fabricated by a talented ceramist. These attributes come from the design of CapekCopings' 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 periodon- tal, abutment color or gingival factors are paramount, consider CapekCopings. It will perform flawlessly under all these conditions while delivering cosmetic results that are un- surpassed 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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