

# All-ceramic Restorations: Strong, Beautiful and Metal Free

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There are many metal-free options for indirect restorations. The indications, cementation protocols and physical characteristics presents a very complex set of data to decipher. We interviewed three luminaries in the world of metal-free dentistry. Join Drs. David Hornbrook, Edward A. McLaren and Jose-Luis Ruiz as they share their insights on this exploding topic.

## Besides improved aesthetics, why should a clinician consider the use of all-ceramic crowns?

**Ruiz:** If used correctly, all-ceramic crowns have a few important advantages over PFM crowns and even gold; they are more biocompatible, more gentle to the periodontium, less tooth reduction is needed, and it is easier to discover secondary caries with these types of crowns. But the main advantages of all-ceramic crowns is that they allow for the placement of supra-gingival margins in the non-aesthetic zone, and equal-gingival in the aesthetic zone. We could generalize and say that it would be desirable to use the stronger more opacous materials in the posterior and the more translucent weaker materials in the anterior, of course there are strong exceptions to this generalization. Traditional porcelain fused to metal (PFM) crown margins must be placed sub-gingivally because they are unattractive. Placing sub-gingival margins adds to the complexity of the crown procedure, one of the most challenging procedures in dentistry is the impression of a sub-gingival margin for a PFM crown,<sup>1</sup> as reported by Dr. Christensen. Intentionally designing and keeping crown margins supra-gingival makes these procedures easier and more predictable; I like to call this supra-gingival dentistry.

**Hornbrook:** If we are discussing the benefits as compared to metal-supported crowns with overlying ceramic, there are many reasons as to the benefits of eliminating metal when placing crowns. One is the ability to be more conservative in tooth preparation. Most metal based crowns require 1.5 -2.0mm reduction. Many of the Leucite-reinforced ceramic systems and lithium disilicate crowns can be fabricated as thin as 1mm, especially on the facial and lingual surfaces. A second reason is “bondability” of many of the all-ceramic systems. We can utilize enamel and dental adhesion to increase resistance and retention form, which can be advantageous on teeth with reduced clinical preparation height. This ability to actually bond to these materials also provides the opportunity to place more conservative restorations such as inlays, onlays, and partial coverage crowns whereas a full coverage restoration was mandated when a metal supported crown is used. A third reason is wear compatibility. Lastly is biocompatibility. Many of the metals used in dental restorations pose an increased risk of galvanic and allergic reactions for our patients.

**McLaren:** Well you hit the nail on the head. Not to be redundant but clearly it is improved aesthetics but from a lab perspective, I train technicians along with dentists at UCLA and I can tell you categorically you work with a young ceramist and lets say a medially talented experienced ceramist it is night and day easier for them to get decent aesthetics if they're not dealing with a metal substrate. For one – just ease of use, predictability. We also get optical properties where light will come in from the adjacent teeth. So in different lights it will match better and that is clearly an aesthetic issue. Number two is, typically with some ceramic systems, we can be a little bit more conservative with our preparation and still get an excellent aesthetic result.

## Is there an all-ceramic crown that you would feel comfortable placing on the cracked lower second molar of a patient with parafunction? Is gold still the standard?

**Hornbrook:** I would feel comfortable placing any number of all-ceramic crowns on a second molar, even with patients exhibiting parafunction. Although many have considered gold the standard, I feel that it is just the most forgiving. The wear resistance and compatibility of gold is certainly not ideal because we know it wears significantly more than enamel. We have all seen gold crowns on second molars that after a few years have hardly any occlusal anatomy and even present with holes that have worn though the gold exposing dentin. Ideal treatment would be to give the patient their original dentin/enamel tooth back. Obviously this is impossible, but we do currently have some all-ceramic systems that have higher flexural strength than enamel. Having said this, I think it is mandatory to determine the cause of the parafunction and see if this can be eliminated. Posterior fulcruming interferences, balancing and working side interferences can all be reasons why a patient might exhibit parafunctional tendencies. My first choice would be a lithium disilicate monolithic crown. This ceramic has shown to have the highest flexural strength and be the most durable of any ceramic currently available.

**McLaren:** Lately the hot topic in dentistry is lithium disilicates. We are actually doing lithium disilicate crowns in that environment. A monolithic lithium disilicate – meaning we are not adding any porcelain to it – is just a block of material. It is either pressed or machined, that we might put a little surface colorant on to get a little gradation of color and actually it looks very aesthetic on a second molar. We have got some short-term data and so far a 100 percent success rate. When I say short term I mean less than two years. I have no problem doing a metal ceramic in that environment or a gold crown but let's face it people have an

aversion to metal in their mouth these days. So what I would have done or what I am doing; we're doing zirconia based crowns but we're very careful about this porcelain problem. In fact the last year and a half we have worked extensively trying to solve this porcelain chipping problem and it turns out it is really not a problem with porcelain, it is a problem with the system. It has to do with thermal firing cycles. So if we pay close attention to frameworks design, if we pay close attention to how we thermally treat the porcelain to the zirconia coping, these things are starting to do as well now as PFMs.

**Ruiz:** Using gold in second molars, especially on patients with parafunctions is a safe but flawed option. If we miss the occlusal adjustment on a second molar gold crown, the crown itself will not break, but something else in the masticatory system will pay for this interference or prematurity, the muscles, the joint, the periodontium, something. There is no doubt that occlusion is the number one reason restorations fail, so it is more desirable to be well versed on occlusion. I feel that if we adjust the occlusion correctly, and we performed the correct tooth preparation design and use the correct type of cement and technique, we could use most of these materials in the second molar.

I am participating in a study with Rella Christensen, in which we have found out that one of the main reason all-ceramic crowns and bridges fail is poor coping/ framework design. Poor coping design is more the norm than the exception. It doesn't matter what brand it is, if the coping is poorly designed it will leave unsupported porcelain and it will be prone to have the veneer porcelain fracture, especially on the marginal ridges. For this reason, I personally have been working with Aadvia zirconia, from GC America, to make sure a consistent anatomical coping is produced.

**With the variety of all-ceramic materials on the market, where do you continue to use PFMs? If you no longer place PFMs, why?**

**McLaren:** Let's differentiate, let's say a pain patient walks in the door who needs a full mouth reconstruction, and where aesthetics is just not the primary issue. Maybe this patient a bruxer and durability is an issue. Maybe we have some chemical issues, erosion and things like that where I am going to have to use conventional cements and maybe moisture control is going to be a little bit of a problem. I would be recommending PFMs at least on the molars and all ceramics anterior to that.

**Ruiz:** For me it is rare to use a PFM crown, the only time when I use a PFM is when I am replacing a PFM, with a very dark cast post and very dark tooth. It is difficult to fully block out a very dark tooth with an all-ceramic crown, not impossible.

**Hornbrook:** Currently in my practice, I no longer use any metal supported restorations. I utilize monolithic lithium disili-

cate crowns in the posterior for single units and Leucite reinforced ceramic in the anterior. I can also use the lithium disilicate for anterior 3 unit bridges. For posterior bridges, I currently use zirconium-oxide supported ceramic. For implant restorations, I use zirconium abutments, so I can place a metal-free restoration over implants as well.

**Are you concerned about the more aggressive preparation design that is required for all-ceramics?**

**Ruiz:** It is a misconception to believe that all-ceramic crowns need more aggressive tooth preparation. It varies depending on which material we are talking about. For example, if we are using zirconia crowns (PFZ), the axial reduction needed is actually less than a PFM. Remember, for a PFM crown it is necessary to do a 1.5mm axial reduction, with sub-gingival margins, and even with this aggressive reduction most laboratory technicians will say they need more space to block out the metal coping and avoid making the crown look opacous. With zirconia, because it is translucent, it comes in different colors and the coping is so strong it is possible to request a 0.5mm zirconia coping, needing only the addition of 0.8mm of veneer porcelain for aesthetics.<sup>2</sup> It is then possible to perform a 1.3mm axial reduction with a chamfer margin design, leaving the margin 0.5mm supra-gingival. For anterior teeth it is possible to request a 0.3mm zirconia coping, with the addition of 0.8mm of veneer porcelain. It is then possible to prepare a 1.1mm deep chamfer with the margin at the gingival level. If the crown is made properly, the blending of the margin will not be objectionable to the patient. Another important benefit of a supra-gingival margin is preservation of tooth structure during tooth preparation. The more apical the margin is placed, the more tooth structure must be removed to maintain the same margin width and taper. The effect of apical placement of margins is, the more apical the margin the more tooth structure is removed, this is due to the narrowing of the root and the needed taper of the preparation, as explained by Shillenburg.<sup>3</sup>

**Hornbrook:** I would disagree with this statement. Zirconium oxide and alumina-oxide supported crowns require a preparation that would mimic that required for a PFM. I can place a lithium disilicate and/or a Leucite reinforced restorations that require significantly less reduction.

**What is your protocol for cementation? Do you prepare the intaglio surface of the crown in any special way? What are your cements of choice? Are there cements to be avoided?**

**Hornbrook:** My protocol for cementation depends upon what type of all-ceramic system I am using. For Leucite reinforced and less than 1.5mm thick lithium disilicate restorations, I use a

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“total-etch” adhesive technique using a fourth generation dentinal adhesive and a dual cure resin cement. On the intaglio surface of these two materials, which are hydrofluoric acid etched by the ceramist, I place a silane coupling agent. When I place zirconium-oxide supported or monolithic lithium disilicate restorations greater than 1.5mm in thickness, I use self-etching dual cure resin cement. On the intaglio surface of the zirconium oxide, I microetch using a Rocatec system.

**McLaren:** With alumina based crowns I would use a lower solubility cement, a resin cement or something like a resin-reinforced glass ionomer like RelyX or Fuji Plus, which is almost used like a conventional cement but has a low solubility. The second part of your question was the internal surface treatment of the coping. Now there are two camps out there and these people are really starting to have a verbal war in the literature and also on podiums these days on whether to sandblast or not sandblast the other side of the coping. This is our protocol: we use 25psi, a 50 micron with a goal of just really cleaning the surface and breaking the surface energy just a little bit. There is some really good research that shows if you lightly sandblast, that these cements like Panavia and Unicem stick better. The light sandblasting will actually increase the adhesion of the cement. So the answer to the question is I lightly sandblast the inside and I either use Panavia or Unicem with these materials if I need increased adhesion. If I don't need increased adhesion, meaning I don't have a short clin-

ical crown or something like that, then I'll still do a teeny light sandblasting to clean the surface because there is usually residue of machining materials in there and I use RelyX luting or Fuji Plus. I use those on posterior teeth because they are moderately opaque. Most of the time if I am using zirconia or alumina on interior teeth I'll use a resin cement – not because of bond strength or adhesion just because I need optical properties. I want translucency. I want the light to pass through. The easiest cement to use with that is shade A2 from Unicem or Panavia.

If I need bond strength and I am going to use Unicem, I apply a separate self-etching primer to the tooth. We use either Optibond all in one or Allbond SE, we are using a thin film thickness self-etching primer, then we put cement inside the crown and seat the thing and that basically doubles the bond strength. If you don't need the increased bond strength just Unicem by itself is OK.

**Ruiz:** It depends on which all-ceramic we are talking about. I believe that because of their weak intrinsic strength, all fedespatic layered porcelain, Lucite reinforced pressed porcelain and lithium disilicate, should be bonded, using an adhesive system and resin cement. Although controversial, to me lithium disilicate is weak, being less than half as strong as zirconia, and so in my clinical experience, is better to bond it. It is important to consider that all bonding systems and resin cements are very intolerant to moisture and contamination. To avoid post-operative sensitivity a resin cement and a self-etch bonding system, like clearfill DC Bond

## Respondent Bios

**David Hornbrook, DDS, FAACD**, graduated from UCLA School of dentistry and currently practices in San Diego CA. He has been a guest faculty member of the post-graduate programs in Cosmetic Dentistry at Baylor, Tufts, SUNY at Buffalo, UMKC, and the UCLA Center of Cosmetic Dentistry. He has consulted with numerous manufacturers in product development and refinement and is on the editorial board of Practical Procedures & Aesthetic Dentistry, Contemporary Esthetics, Signature, and is the past editor of the *Journal of the American Academy of Cosmetic Dentistry*. He is also the current clinical editor of the Dental Practice Report, as well as a member of the Esthetic Dentistry Research Group, which publishes REALITY and REALITY NOW. He is an accredited member and Fellow of the American Academy of Cosmetic Dentistry. He was the founder and past director of P.A.C.-live, and The Hornbrook Group Center for Advanced Continuing Education. He has lectured internationally on all facets of aesthetic dentistry and has published articles in most of the leading dental journals.



**Edward A. McLaren, DDS**, attended the University of Redlands where he graduated Phi Beta Kappa and Magna Cum Laude. He received his DDS from the University of the Pacific School of Dentistry, where he graduated Omicron Kappa Upsilon. After several years of general practice, he received his specialty certificate in Prosthodontics from UCLA School of Dentistry. Dr. McLaren maintains a private practice limited to prosthodontics and aesthetic dentistry in which he does all of his own ceramics. He is the director of the UCLA Center for Esthetic Dentistry, a full time didactic and clinical program for graduate dentists. He is also the founder and director of the UCLA school for Esthetic Dental design. The school is a full time program for dental technicians featuring extensive experience with the newest aesthetic restorative systems. Dr. McLaren has an appointment as an Associate Professor in the Biomaterials and Advanced Prosthodontic department. He is also an Adjunct Assistant Professor for the University of Oregon Dental School. Dr. McLaren is actively involved in many areas of prosthodontic and materials research and has published several articles. He is performing ongoing clinical research on various restorative systems. He has presented numerous lectures, hands-on clinics and postgraduate courses on ceramics and aesthetics across the nation and internationally. He recently published a book, on his ceramic techniques and features dental photographic art, titled, *The Art of Passion: Ceramics, Teeth, Faces, and Places*.



**Jose-Luis Ruiz, DDS, FAGD**, is clinical instructor and course director of the University of Southern California's Esthetic Dentistry Continuum. He is an associate instructor at Dr. Gordon Christensen PCC in Utah and The Scottsdale Center, and an independent evaluator of dental products for CRA. Dr. Ruiz has been practicing in the studio district of Los Angeles for more than 18 years and enjoys a clientele of many stars and entertainers. Dr. Ruiz has made numerous television appearances highlighting his aesthetic dental makeovers, including NBC Channel 4 News, ABC's Vista L.A. and Channel 52's Telemundo. His focus is on treating complex cosmetic, rehabilitation, and implant cases and he lectures nationally and internationally and has published many research and clinical articles on aesthetic and adhesive dentistry.



and Esthetic Cement from Kuraray would be a good choice. Great effort to keep margins supra-gingival should be made; this will facilitate the bonded cementation.

### What is the future for all-ceramics?

**McLaren:** I get asked that a lot and here is what I believe. I believe in the near term let's say up to five to 10 years we are going to see continued growth in the zirconia area. We see that growing 10-20 percent per year but I think that is going to eventually die out. I think the real future is going to be these newer generation materials like the lithium disilicates – very high strength materials that we can bond or not bond that have inherent translucency built into them that we can use as monolithic structures. That is already available with something like Ivoclar Vivadent's e.max.; meaning we don't have to have a core system and separate porcelain. We just have one material. I think the future will be that we all are going to have a chairside scanning unit. I think we'll have intraroral scanners and I think what we will do is upload data to a lab that is very close to us and we'll let our laboratory colleagues machine a block or an inlay/onlay and deliver it two to three hours after we scan it.

**Ruiz:** Great question, I believe that all-ceramics will eventually replace metals in dentistry. Over the next few years we will see that some all-ceramic materials will improve in physical characteristics, and we as a profession will learn how to use them better, all

of this combined will mean predictable clinical success. Much of the failure today with all-ceramic is due to improper use, just like with posterior composites a few years ago, we are going thru a learning curve. Not one material can be used in all clinical conditions. Learning what material is best for each clinical procedure and how to better use the material will lead to a much better success. One of my personal hopes is that as a profession we will discover that all-ceramic materials have the characteristic of being translucent, and this allows for a better margin blend with the tooth and allows us to place the margins of our restorations supra-gingivally. When we realize the dramatic benefits of performing supra-gingival dentistry, the quality of our dentistry and the health of our patient's periodontium will benefit greatly.

**Hornbrook:** I think the future will be continued development of stronger all-ceramic systems that exhibit increased translucency. It would be ideal to have a translucency, bondable ceramic that exhibited the strength necessary to fabricate multiple unit bridges. I believe the future will present metal-free as the standard of care for indirect dentistry. ■

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