IN THE SPOTLIGHT: Restorative Dentistry

In recent years, social media has been abuzz with talk of restorative dentistry, and as a result, patient expectations have never been greater. While we all know the downsides of social media, it has also served as a hub for collaboration, inspiration, and education among dental professionals. Dental Economics understands that exceptional clinical outcomes and exceeding patient expectations are integral to the foundation of any successful practice. In this e-book, some of our most esteemed authors share their secrets for making clinical decisions and executing technique-sensitive procedures to deliver excellent, lasting restorations.

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

DENTAL ECONOMICS®

TABLE OF CONTENTS

Zen and the art of veneer provisionalization 3

Composite restorations: Is Instagram reality? 13

Clinical case studies: A streamlined dental cementation protocol for low-retention restorations 24

Choosing between complete (crown) or partial coverage (inlay and onlay) restorations: What will last? 30

How to increase predictability and durability of posterior composite restorations: A case study 39

Combining glass ionomer, IDS, and CEREC for intelligent hybrid restorations 43

ZEN AND THE ART OF VENEER PROVISIONALIZATION

Provisional veneers are crucial for protecting teeth, maintaining esthetics, and serving as diagnostic tools before final restorations. Dr. Austin shares his journey of trying various techniques, and provides step-by-step fabrication guides, highlighting the necessity of preoperative lab work and patient care during the provisional phase.

BY JOSHUA AUSTIN, DDS, MAGD

Anterior esthetic procedures—particularly ceramic veneers—are some of my favorite procedures to see on the schedule. They are challenging, add great production to the practice, and can be life-changing for patients. I have never changed a patient's life with a DO composite on a lower first molar. Veneers, on the other hand, can give us those moments that reaffirm why we chose dentistry.

The one aspect of these indirect anterior esthetic cases that seems to be the most stressful is the provisionalization. The entire time I'm preparing and imaging a veneer

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

case, in the back of my mind I'm thinking, "Damn … in a little bit I'm going to have to make temporaries for these. Are they going to turn out OK?" It's like a gnawing little thought worm that penetrates my brain and clouds the entire procedure.

Throughout my career, I've tried many different methods to make provisionals for these types of cases, and many times I've failed. Each time I failed, I learned something different, and from those failures and lessons, I have adapted my technique. I feel confident that I've found the veneer provisionalization technique that works the best for me (figure 1).

figure 1

WHY PROVISIONALS ARE SO IMPORTANT

Before we start with the step-by-step technique, let's look at the purpose of provisionals. Provisionals accomplish several tasks during their time in service. Obviously, they cover the exposed tooth structure to prevent sensitivity and pain. They also serve esthetically, so patients don't have to walk around with prepared teeth in sight. Provisionals also keep the prepared teeth from shifting during the laboratory fabrication time. These are basic, simple principles of provisionals whether they're anterior or posterior, esthetic or not.

Provisionals for anterior esthetic restorations serve another, even more important purpose that's generally not necessary on simpler posterior procedures—diagnostics. Provisionals can give us and our patients a preview of the final result, which matters esthetically and functionally. We want to make sure that the dimensions of the teeth are right for the patient's face before the final restorations are fabricated. We want to ensure that the patient's function works while in the provisionals and that we don't have units breaking off left and right. These are the reasons why we must put work into making provisionals, basing them off what we want our final restorations to be—not just replicating the preoperative state of the patient.

For a single unit on a lower first molar, there's no problem with snapping a quick impression of a tooth before preparing it and using it to make the temporary. Unfortunately, this simple process just doesn't work for more complex anterior indirect procedures. We must invest time in the lab before the procedure in order to produce provisionals that will give us the information we need to proceed to final restorations.

In addition, our patient will have paid us a lot of money on the day of their preparation procedure, and they deserve to look better when they leave than when they came in. Spending time and effort on the provisionals will ensure this.

PREOPERATIVE LAB WORK

Investing a few minutes of time in the lab will pay big dividends with less time and effort required in the operatory on preparation day. This comes in the form of the matrix that we use to fabricate the provisionals. The better and more accurate the matrix is, the better and easier the provisional restorations will be.

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

When it comes to making the matrix, we have three material options.

A vacuum-formed thermoplastic clear tray: This type of matrix offers a couple of distinct advantages. First, it's cheap and easy to make, and pretty much every dentist has the equipment and supplies to make it. It's clear, which enables us to see through it to ensure there are no voids or bubbles in the material before we seat the matrix. It also allows us to cure through it if we're using a dual-cured material. That's where the advantages come in.

The main disadvantage of this type of matrix is that it's just not detailed enough. It doesn't have enough resolution to produce anatomic, esthetic provisionals. Using a matrix like this necessitates a lot of time spent on finishing and polishing due to its low resolution. My laboratory sends me one of these on every diagnostic wax-up they do for me. I never use it to make the provisionals; I only use it as a reduction guide. I would not recommend using this for a matrix (figure 2).

Putty-wash PVS: This is by far the most common matrix used for these type of procedures. Many labs will fabricate these and send them along to the doctor with the diagnostic wax-up. If the lab doesn't fabricate it, most dentists have putty and wash materials in their office, making it easy to create the matrix in-house. The resolution is much better with this method than a vacuum-formed thermoplastic tray, so we get much better resolution, anatomy, and surface detail.

The main problem with a putty-wash matrix, however, is that you can't see through it, so you can't see and correct voids and bubbles until you remove the matrix. No matter how hard you try, bubbles and voids will happen, and they tend to occur most frequently on incisal edges and facial surfaces. This forces you to correct them using additional steps and more time. Every time you add to the provisionals to fix a bubble or void, you also create a lamination in the material that can chip, stain, or break. In addition, the layer of bis-acryl GMA that touches the matrix never sets. Because the material must self-cure when using this type of matrix, the layer that touches the PVS material doesn't set and comes out in the matrix after it's removed, losing some of the resolution, sharpness, and surface detail. For those reasons, I would not recommend using this type of putty-wash matrix (figure 3).

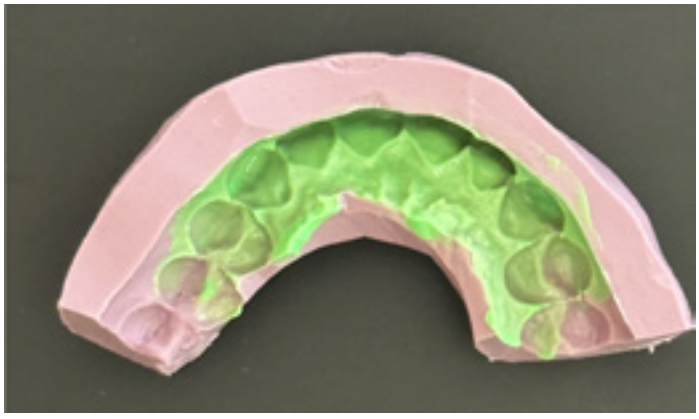


figure 2 (left)
figure 3 (right)

Clear PVS bite registration: This is my favorite material to use to make a matrix. It offers some distinct advantages over the other two materials. Firstly, the material is translucent, so you can see voids and bubbles before the matrix is ever seated. This way you can fix the problem before it becomes a problem. A clear matrix is required for this, and clear PVS fits the bill perfectly. Secondly, the resolution is excellent and similar to the resolution of a putty-wash matrix. The better the matrix's resolution, the better the provisionals will turn out. Thirdly, because the material is clear, I can cure through the matrix (assuming the bis-acryl GMA material is dual-cure). This prevents the top layer of provisional material from sticking inside the matrix and reducing surface detail, anatomy, and resolution.

The one disadvantage of clear PVS bite registration is that most dentists don't stock it regularly in their office, so you'll need to order it specially for these types of cases. In my opinion, it's totally worth it. There are several options on the market, and I've tested them all. They all work similarly well, but Exaclear by GC America is my first choice because of how clear it is. It is significantly clearer than some of the other options, which allows me to see through and cure though it better (figures 4 and 5).

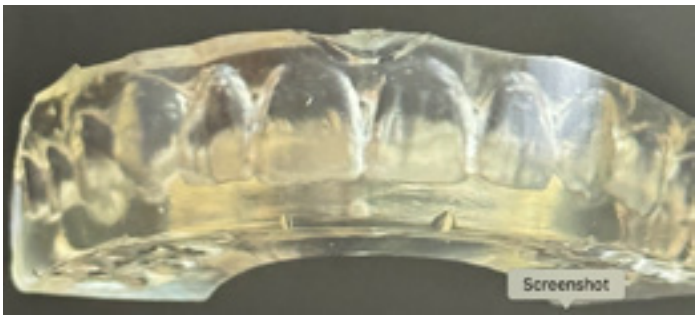


figure 4

figure 5

MAKING THE MATRIX

Now that we've chosen the matrix material, we can begin the work of actually making the matrix. This will involve the following laboratory materials and equipment:

- A diagnostic wax-up (figure 6)
- A Rim-Lock impression tray (figure 7)
- Clear PVS bite registration material (figure 5)
- A hydraulic pressure pot (figure 8)
- A green Buffalo lab knife
- A #12 blade scalpel

figure 6

figure 7

figure 8

DIAGNOSTIC WAX-UP

The diagnostic wax-up is important to the entire process. We want to make the provisionals based on the design of the case during the diagnostic phase. Most diagnostic wax-ups done at dental labs in 2024 are done digitally, and then a model is 3D-printed. That will work perfectly for this method. A traditional diagnostic wax-up done with a stone model and drip wax will also work. Whether the wax-up is digital or analog, it will work with this method. A Rim-Lock tray is my choice for this method because it has no holes. We will need to get the matrix out of the tray, and a tray with holes makes this more difficult. I have an assortment of upper and lower Rim-Lock impression trays in different sizes in my laboratory.

Choose the size that works the best for your wax-up model and go with it. Don't use adhesive. The clear PVS bite registration should be kept in the refrigerator, because that will slow its set. Sometimes we need a longer setting time for full-arch matrices. This material lives in my office refrigerator, so it's always chilled and ready.

A hydraulic pressure pot is the one item on the list that many dentists don't have, but it makes a big difference. The Rim-Lock tray loaded with clear PVS and the diagnostic wax-up model go into the pressure pot filled with water before the clear PVS sets. The pressure in the pressure pot will force the clear PVS to adapt closely to the wax-up, giving us ideal resolution and definition. This extra step makes a difference. If your practice has a pressure pot that's used for acrylic procedures, that will work well. I don't own one of those large traditional pressure pots. I use a hand-cranked hydraulic pressure pot from Keystone Industries that cost about $300.

FABRICATING THE MATRIX

Here is my step-by-step process for fabricating the matrix in the laboratory:

1. Have all materials in the lab ready to go.
2. Load the Rim-Lock tray with chilled Exaclear.
3. Syringe a layer of Exaclear around the teeth being prepared on the wax-up.
4. Seat the diagnostic wax-up model into the loaded Rim-Lock tray.
5. Put the tray and model into the hydraulic pressure pot filled with water.
6. Close the pressure pot and crank until a pressure of 15–20 psi is reached.
7. After five to seven minutes, release the pressure on the pressure pot and open it.
8. Retrieve the tray and model from inside the pressure pot and dry it off.
9. Use the green-handled Buffalo knife to pry the model out of the set Exaclear.
10. Use the green-handled Buffalo knife to pry the matrix out of the Rim-Lock tray.
11. Carefully trim the matrix with the #12 blade.

A video of this process can be found on my Instagram feed @JoshuaAustinDDS.

Ideally, matrix fabrication should happen the night before an esthetic procedure. PVS of all kinds releases hydrogen sulfide gas immediately after setting. If the matrix is made the day before the procedure, it gives the matrix an opportunity to de-gas so no bubbles will form on the surface of the provisionals. If this is not possible, make the matrix the day of the procedure, and then place it in a plastic baggie in an alginate bowl of hot water. That will cause the set PVS to de-gas while the preparations are being done.

PROVISIONAL WORKFLOW

Once the teeth are prepared, photographs taken, and impressions and bite registrations made, it's time to begin the provisional fabrication procedure. The material of choice for most provisionals in restorative dental practices in 2024 is bis-acryl GMA. These materials are widely prevalent due to their strength, polishability, and workflow efficiency. I've never worked in a dental practice that did not routinely use a bis-acryl GMA material on a regular basis.

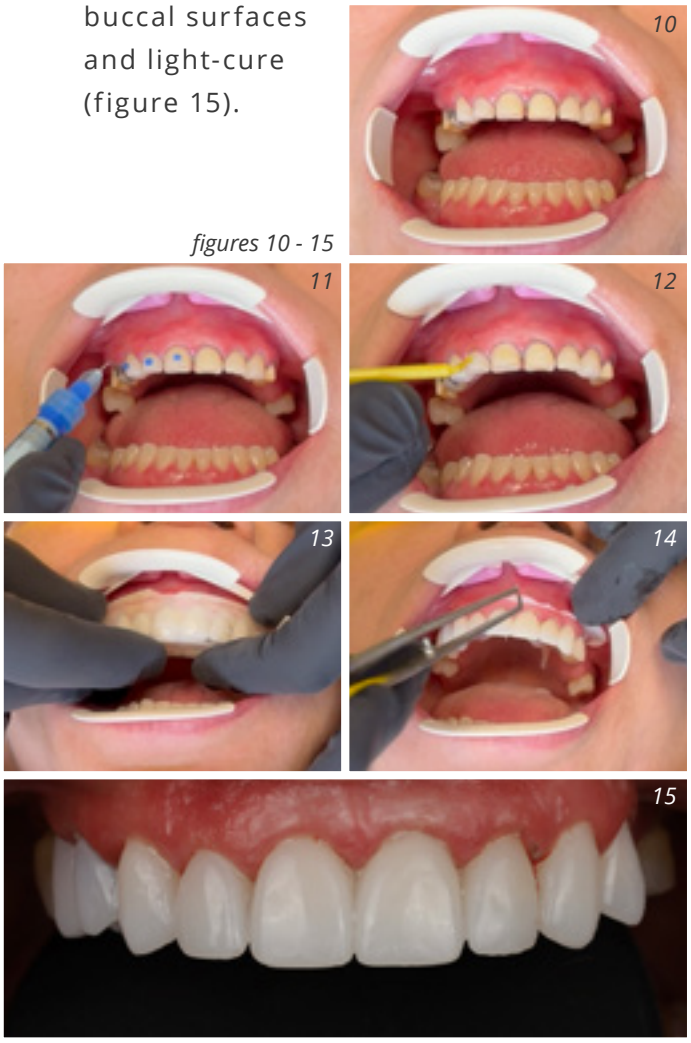
There are some features I prefer in the material used for esthetic provisionals. I prefer a dual-cure material, because light-curing it through the clear PVS matrix will prevent loss of the top layer of provisional material and the associated detail and surface anatomy. I also prefer a bis-acryl GMA material with a flowable repair material and light-cure glaze included. In the event that I do get a defect, bubble, or void, I can repair it quickly and easily using the matching flowable. The light-cure glaze is a nice last step to take the provisionals to the next level esthetically. While there are many great choices on the market for bis-acryl GMA materials, my choice is Tuff-Temp Plus by Pulpdent. It's dual-cure, and a flowable repair material and light-cure glaze are included in the kit. The rubberized monomer in Tuff-Temp Plus gives some resiliency that's excellent for function on long-span provisionals (figure 9).

figure 9

The process of making the esthetic provisionals is fairly simple once we have the excellent matrix made in the laboratory the day before. This is the workflow to fabricate chairside esthetic provisionals:

1. Remove retraction cords and isolate the teeth using a retractor—e.g., Optragate, Hoopla Retractor, etc. (figure 10).
2. Rinse and dry the preparations.
3. Spot-etch with 35% phosphoric acid etch for 10–20 seconds (figure 11).
4. Rinse away the etch, and dry the preparations.
5. Spot-bond with a universal bonding agent of your choice (figure 12).
6. Blot excess bonding agent with a clean applicator or cotton pellet.
7. Light-cure spot-bonded adhesive.
8. Load the matrix with the bis-acryl GMA material, ensuring there are no voids or bubbles.
9. Seat the loaded matrix, and hold in place (figure 13).
10. Light-cure the bis-acryl GMA through the matrix for about five seconds per tooth from buccal and lingual.

11. Remove the matrix and large chunks of excess bis-acryl GMA (figure 14).
12. Remove flash, and adjust occlusion.
13. Apply glaze to buccal surfaces and light-cure (figure 15).



figures 10 - 15

A video of this process can be found on my Instagram feed @JoshuaAustinDDS.

No matter the preparation style—minimal prep, maximal prep, broken interproximal contacts, etc.—I feel the need to spot-bond the veneer provisionals to the enamel. This gives a little bit of extra retention, which is necessary as the provisionals need to be in function for at least two weeks or more. The size of the spot-etch and -bond will vary depending on the prep style. If we have done a more traditional preparation with broken interproximal contacts, the spot-bonding is belt-and-suspenders. The size of my spot-etch and -bond will be much smaller—maybe 2 mm round circular spots of etch and bond. However, in minimal or no-prep situations, we'll be relying on the spot-bonding to keep the veneers in place. In this situation, my spot-etch/bond size will be maybe 4–5 mm (figure 16).

figure 16

When spot-bonding with a universal adhesive, we need to take a precaution. Typically, when using an adhesive, we're conditioned to want to apply the adhesive and then immediately air-thin it with an air-water syringe. But we don't want to do that here because it will spread out the area of bonding and make removing the provisionals more difficult. Instead, blot any excess with a clean microbrush or cotton pellet.

LOADING THE MATRIX

Once we've spot-etched, spot-bonded, and light-cured, it's time to load the matrix. This should be done quickly and efficiently while

keeping the tip of the bis-acryl GMA material within the material to prevent voids and bubbles. If you do observe a bubble or void through the matrix, put the tip of the bis-acryl GMA material right into the void and continuously express more while withdrawing it. That should eliminate the void. Voids almost always occur around incisal edges of incisors. Be on the lookout for voids and bubbles there before you seat the matrix.

Once the matrix is filled, seat it in place and begin to light-cure. If you don't want to use a dual-cure material, just wait for the chemical curing to take place. One reason I like Tuff-Temp Plus so much is that I can light-cure it and save about five minutes. After the bis-acryl GMA is set, remove the matrix. You'll find large fins of excess around the edges where the matrix set in the buccal vestibule and on the palate. Remove these with cotton forceps.

If the matrix was made well, there should be little to no finishing necessary on the buccal. Apart from defining some line angles with a sharp flame-shaped finishing bur, there should be almost nothing to finish here. The majority of finishing will come on the lingual surfaces. This can be accomplished easily with #12 fluted carbide finishing burs at around 40,000 rpm. To adjust occlusion, I usually use a sharp flame-shaped finishing bur and a football-shaped bur. Once the provisionals are finished and the occlusion is adjusted, I dry them off and paint the light-cured glaze on the buccal surfaces. Light-cure for about 10 seconds per tooth.

Once the provisionals are finished, I scan them so I can send the laboratory a record of the provisionals. The provisionals are usually based on a diagnostic wax-up that the laboratory did, but it's always helpful for the lab to have a record of how the patient looked when they walked out the door on prep day.

PATIENT EDUCATION AND ORAL HYGIENE INSTRUCTIONS

Warn the patient that the provisionals are splinted together and that they won't be able to floss between them. I explain why the provisionals are splinted together and offer some oral hygiene instructions. I let the patient know how important it is to brush well around the provisionals, because we want to keep the tissue healthy for the delivery appointment. To help maintain interproximal tissue health, I prescribe dexamethasone elixir (.5 mg/5 ml) and advise the patient to swish and spit with 10 ml for 30 seconds twice a day. I recommend they focus the swishing around the front teeth where the provisionals are. This keeps the tissue healthy despite the patient's inability to floss. These provisionals were in the mouth for more than six weeks and had no gingival inflammation (figure 17).

figure 17

THE RECALL APPOINTMENT

I see the patient back in three to five days to check occlusion, assess how they feel about the esthetics, and take photos. If I need to make any adjustments, I rescan the patient to show the lab the changes we made. If it's just a simple veneer case, the laboratory is ready to start making the restorations. If we're making a big change such as a full arch of ceramics and opening a vertical dimension, I let the laboratory know to wait until I give them the go-ahead to start designing and fabricating the final restorations. I see those patients again after two weeks to see how they are doing functionally and esthetically.

DELIVERING THE FINAL VENEERS

When the patient comes back for delivery day, we have to tackle the hard part—taking off the provisionals that we spent so much time and effort on. This is never easy, nor should it be. The way I see it is, you have to pay the dues in one way or another. If you make the provisionals easy to remove, then you'll be seeing the patient back every few days to repair or replace them. If you fabricate the provisionals in such a way that they stay secure, esthetic, and functional throughout the process, they will be a challenge to remove. With that being said, the provisionals can be removed in about one to two minutes per unit if you work efficiently.

I always start by anesthetizing the patient. Once numb, I take an 856.012 bur at 20,000 rpm and place a score-cut on each provisional from incisal to gingival, careful not to touch the marginal area (figure 18). If the preparations have broken interproximal contacts, I'll also place a score-cut in the interproximal area between each veneer provisional (figure 19).

figure 18 (top); figure 19 (middle); figure 20 (bottom)

Once, each veneer and contact area have a score-cut, I take a Christensen Crown Remover and pop off as much as I can (figure 20). After the big pieces have popped off, I use a scaler and hemostat to work off the smaller pieces. At this point, the only bis-acryl GMA that

remains is in the area that I spot-bonded. In those areas, I take my diamond bur on 10,000 rpm dry and dust off the provisional material slowly. Once this is done, I'm ready to try-in the final veneers.

The process of fabricating chairside provisional veneers is not easy; these procedures are high in value and production. They're also big investments from our patients in time, trust, money, and emotions. Our patients will need to live with these provisionals for weeks at a time. The least we can do is give them the best provisionals we can. The technique in this article will allow you to do that in an efficient and effective manner.

Joshua Austin, DDS, MAGD, is a graduate and former faculty member of the University of Texas Health Science Center at San Antonio School of Dentistry. Author of Dental Economics' Pearls for Your Practice column, Dr. Austin lectures nationally on products, dental technology, online reputation management, and social media. He maintains a full-time restorative dentistry private practice in San Antonio, Texas. You may contact Dr. Austin at jaustindds@icloud.com.

COMPOSITE RESTORATIONS: IS INSTAGRAM REALITY?

We asked one of dentistry's finest clinicians, Dr. Peter Auster, to walk us through how much we can really trust. His insights … well, let's just say they might surprise you!

BY PAMELA MARAGLIANO-MUNIZ, DMD; DAVID R. RICE, DDS; AND PETER AUSTER, DMD

DR. MARAGLIANO-MUNIZ:
Hey everyone. Welcome to *Dentistry Unmasked*. I'm Pam Maragliano-Muniz. And with me, as always, my partner in crime ...

DR. RICE:
Hey, Dr. David Rice! How are you today, Pam?

DR. MM:
I'm doing so well and I am so excited to talk about this topic, because I feel like I've spent the past few years now trying to—I won't say perfect, because I don't think I'll ever get there—but *master* composite restorations. I used to have a 'tude with composites. I used

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

to be like, "I'm a prosthodontist, I don't care about composite." And then I got into private practice and I was like, "Okay, the reality is, you have to get comfortable with composites."

I realized I wasn't comfortable with them, so I've spent the past several years trying to get better and better at it. And I love every second I get to spend with our guest, because I always learn something, I'm always inspired, and I just like you. Dr. Peter Auster, welcome.

DR. AUSTER:
Thank you. It's wonderful to be here again.

DR. MM:
So happy to have you here. I'm sure many of our listeners can relate that I scroll on Instagram, and even though I'm really trying hard to get my Instagram to be just baby goats, maybe some ducks and some fashion, composite restorations and dentistry are still always part of my page. And, I don't know if I'm jealous or if I'm skeptical about some of the cases that I see. Are they even real? What is your take on some of these cases we see out there on the 'gram?

DR. A:
I don't know. I think maybe 70% aren't totally real, but it depends what they're doing and how they're doing it. There's a lot of new stuff out there. I don't remember exactly what materials we talked about in the last podcast, but there's a lot of new, cool stuff. Omnichroma started this trend of less shade restorations, but now there's a bunch of really cool stuff. Ultradent just came out with a great composite, it's called Enhance. SimpliShade's been around from Kerr for a while. G-ænial A'CHORD, which is a GC product, is kind of cool.

Kettenbach is a small company that only comes out with good, interesting products. None of them can be pronounced well, I believe it's Visalys Fill, but it could be pronounced in nine different ways. And then GC, G-ænial A'CHORD, but that's another story, in terms of names. The companies are making our lives easier and better, in terms of what we can do.

DR. MM:
Speaking about photography, you are part of the AACD, in the upper echelon of cosmetic dentistry, and I feel like, as a prosthodontist, 99.7% of the time, I will look at photos of my work and there's always something I would change. I'm never 100% happy. My husband might say I'm just not easy to please, but I know that I'm never overly impressed, and it's hard for me to put them out there because if I don't really love them, I'm like, "Nah, I know I would change this or fix a line angle" but the patient's happy and it's still in there. So that's pretty good.

What's your take on people who post these cases that are outrageously incredible all the time? Does that really contribute to clinical success and practice success?

DR. A:
I'm not sure what they're doing and how they're doing it. I know a lot of people at the AACD, and I've been with them for a long time. There is a limited number of people who do fabulous composites every time. The David Chans of the world—they're remarkable. But even the people who are accredited at the AACD, even the fellows at the AACD do wonderful cases. Is that

true for every one of their cases? No, because there's a lot that you have to do to make a case perfect, and there's a lot of time you have to spend to make cases perfect.

I don't know how these cases are coming out the way they are. I'm not sure if some of them really are composite veneers. They could very well be porcelain veneers.

DR. MM:
Are you saying that there's a chance that people are posting porcelain veneers and saying they're composites?

DR. A:
There's a chance that people are lying on social media? No … I don't think so.

DR. MM:
Wow. David, you work with so many younger dentists that I think feel a lot of pressure to perform on social media because, at the end of the day, life is about likes, right? And influence. What do you say to them? And is that pressure real?

DR. R:
We've talked in the past about imposter syndrome and, Peter, one of the things that I took from our time last time, was it took you what, 15 years to really feel great about what you were doing every day. And to your point, Pam, all these young dentists are on there and they wonder every day, "Am I good enough?"

So, when we talk about 70% as a ballpark of photos that are, I'll be kind, retouched in some way, that some dentists are putting out there as reality, that's horribly unfair. It's a problem for our industry at large. Within the last 10 years, we were in the top three most trusted professions. Where are we today?

And when we think we're being innocent by posting something misleading, that affects trust from our patients, it goes to emotional damage especially to young dentists, and students who feel like, "Oh gosh, how am I going to achieve that and do that?" I think it's a massive problem in dentistry today.

DR. A:
The other thing that's interesting is that what we look at isn't necessarily what patients are looking at. There's a cosmetic dentist in—I'll be careful about where—in one of the more expensive parts of California, let's call it that, who is constantly posting his veneer cases. And most of them are awful. First of all, every one of them is toilet-bowl white, which is a very interesting shade, as far as I'm concerned. And, of course, everyone in California is tan, so the toilet-bowl white looks even worse. And people are just glowing in the way they feel about these cases. And the gingiva looks lousy, I mean nothing looks good about it, but the patients are going wild over it.

The perfectionism that is part of you and me is like, we want them to be perfect. But patients don't necessarily care if they're perfect unless they're that kind of patient, which is another story.

One thing I've got to say about composite veneers these days is if you take a look at what you've done, so many times I will do it and it looks fine when I'm sitting behind the patient, and then I say, "I've got this, they're the same size, the contacts are good, everything's great."

Then I walk about three feet in front of the patient and the four-letter words start coming out of my head. And it's like one is bigger than the other, one's rounder than the other. Part of the problem is how long it takes to do it, which is a very long time to do a single veneer.

One thing that I've been working with these days, there are a couple of options out there for doing composite veneers faster and better. And one of them is something called SmileFast, which is a company out of England who've come up with this incredible way of creating six or four or eight composite veneers in an hour. And they're beautiful. We're talking about something completely different than what we're used to.

I went to one of their seminars a couple of months ago, and I'm going to another one in a couple of months, and I was really impressed because it's a way to do that stuff so much faster. They call it "pressure molding," as opposed to injection molding, and it's marvelous. And all companies are starting to come out with that. 3M's got their version of it, which is very interesting. It's called Filtek Matrix, and it's very interesting, where you basically—it's also heated materials and that's what seems to be really taking over dentistry, and that's heating composites.

And when you heat these composites and you can soften them and basically spray them through a hole or, in terms of this Filtek Matrix thing, you're actually doing something, I think they call it closing the door or closing the window. You're spraying the material in, and then you shut the window on top of the material and it comes out pretty good. I wouldn't say the cases are fabulous, but they're every bit as good as what you're doing with a composite matrix by doing it yourself, unless you really have great ACD training. The SmileFast to me actually gives you better cases. You actually get cases that truly look like porcelain veneers, which is pretty cool.

DR. MM:

It's interesting coming from you too because I think that—and I don't know if it's the prosthodontist in me or just the negative Nancy—when I hear doing something that technique-sensitive and that stress-inducing to be something that comes out in an hour, my initial reaction is, I don't think that's possible. There's no way. To hear you say that, that makes me think, all right, I know Marty's introduced me to SmileFast and was like, "You should come to a class." And I was like, "I don't know, veneers in an hour? That's not my jam, I like to do them in four. You know?" But, clearly, it sounds like they're onto something.

DR. A:

Well, you're using imaging and getting virtual diagnostic wax-ups, and instead of using those diagnostic wax-ups to create porcelain veneers, you're using them to create bonded veneers. So, they've taken the challenges out of it, and if you don't like the vision of it that they've created, if you don't necessarily like the wax-ups, you change it before you do the final case.

DR. R:

Clearly everybody's going to come to market with their version. What are the key elements that will separate those delivering a superior restoration to one that might get us kind of close to what we did before?

DR. A:
I think part of it is heating composites, and it depends on what composite you're using. I've spoken to SmileFast, they've actually changed the system they've used several times. They started using a 3M system, now they're using an Ivoclar system, I believe they're using Empress Direct, which I haven't loved as a composite, but I really love it with SmileFast. What I'm finding is that some materials actually do better if they're heated and some of them do far worse.

The other thing that's very interesting that I've been using is VisCalor. It is a Voco product, which is very interesting. It's the first product ever that's made to be heated. They actually created a material that doesn't work if you don't heat it. That frightens me a little bit about other composites out there where you're heating something that was formulated to be put in at 72 degrees, and you're putting it in at 103 degrees. What happens to that, long-term? I don't think there's a lot of long-term testing. There are a lot of benefits to heating composites, because if you're going to create something that's flowable, you're going to get less microleakage and less problems on the margins. But what kind of shrinkage are you going to get after five years?

DR. MM:
This is sort of what Bioclear has been doing for years. Some of the cases I've seen last a long time, they've got great contours, and the margins are imperceptible. I think there's definitely something to be said about it. But you're right, you should always refer to your manufacturer's recommendations on whether or not composite can or should be heated. It is interesting, because the recommendations are all over the board.

DR. MM:
I'm going to put you on the spot, and I don't expect you to know this, because David and I were talking about this earlier, and we don't know. Some of the almost-generic composites that are out there—like Patterson brand, Shine brand composite—it's just like some random composite out there. Have you ever used them? Do you know who makes them and what's up with that?

DR. A:
You're not going to like this answer. I think I mentioned to you guys last time that I do volunteer work in the Caribbean every year?

DR. MM:
Yes.

DR. A:
There is a company—may have been one of the companies you mentioned—that actually provided composites for us. In the past, I would bring Tokuyama products there because I absolutely have trust in everything they do. Omnichroma is marvelous, because you can use it for every shade tooth and it's great. But I used one of those company's composites, and of course it's hot there, and we're working in 99-degree temperature, so it's different than working at home. I would put the composite on the front surface of the tooth and it would leak. It literally melted in the patient's mouth.

If it's doing that just because of the heat, people's mouths become very warm as time

goes on. You eat some soup—is that going to melt your composite? I'm not a fan of off-brand, at least not the ones that I've used or the ones that are put out there by the manufacturers.

DR. MM:
We were hoping that, for example, sometimes really well-known brands make them for the off-label. We were just wondering if there was a hidden gem somewhere. But not in your experience?

DR. A:
Not in my experience. And the one I'm talking about is one of the most major supply companies in the world.

DR. MM:
Alright, well that's good to know. We can move on from that.

DR. R:
Let's be honest, think about how many practices out there—large and small—are trying to shrink overhead, and they're exploring products and tech from big-name folks, or just no-name folks, in an effort to do the same job. And reps are good people, but they don't know the science. This is happening all day, every day in practices all over the world.

DR. A:
I can tell you about products that are not off-label brands, but they're actually companies that make products that are less expensive.

Kettenbach makes products that can be anywhere between 20% and 30% less in cost than other companies. Their byproducts are second to none. They also make something called Silginat, which is an alginate substitute, and there's nothing better. And it's 30% less than what the major manufacturers are charging.

Voco makes a lot of inexpensive products that work just as well as the other products that are on the market. DMG does some of that. I like the smaller companies. I think they have to get their stuff out there, but they're good. Do you want me to tell you've been a couple of products on the market that I just got?

DR. MM:
Yeah.

DR. R:
Love it.

DR. A:
I mentioned Enhance, which is a product I really like. It's very interesting and I'd recommend it in the syringe kit as opposed to compules, which is the first time I've ever recommended that, because that's not my thing. It seems to work better in a syringe. There are the two new Omnichroma products that are out, their bulk product is very interesting. Their flowable composite is pretty cool. I'm still in favor of the actual Omnichroma.

Garrison, which is a smaller company that seems to come out with among the best matrix systems ever. Just came out with something called Strata-G, which is a cool name. I always loved their matrix systems before, and these are better. A number of very cool, very interesting curing lights on the market right now. Have you guys tried the Monet light by any chance?

DR. R:
I have, yes.

DR. A:
Very interesting product. Has some potential benefits to it because of the laser and because you're getting a spray that doesn't deflect. What you get with a blue light source is, as you hit the tooth, it starts to go that way, whereas a laser light goes straight down into the tooth itself. Vista Apex, another interesting company, came out with something called the Pinkwave. Have you tried that?

DR. R:
No.

DR. MM:
It's pink. Of course.

DR. A:
The benefit to pink is that you get ... First of all, there are three different forces at the same time. So you're getting different kinds of curing from each of the different waves that are coming out at the same time. And also, they claim that you're going to be curing further into the box, which is kind of cool.

DR. R:
Turns out insufficient depth of cure is a big reason adhesive dentistry doesn't work out so much.

DR. MM:
I was just going to get on my soapbox and talk about curing lights and making sure that they're functioning properly. I am amazed the more I learn about the science of composites and turnover … it's amazing that they work as well as they do. You would think that every duck really has to be in a row from isolation to proper bonding, to handling your composite to proper polishing, like all the things.

DR. A:
Of course.

DR. MM:
And your curing light plays a huge role in that. So, regardless of the curing light you're using, make sure it's functioning properly. Test that thing. Just because it turns on doesn't mean it's working.

DR. A:
Take a look at the tip of it, because there's probably some composite on the tip, and that'll mess up the curing a lot. Make sure if you don't have something to test it, get something to test it.

DR. R:
Absolutely. I see way too many practices out there trying to shop for that super inexpensive light. Maybe the batteries are fully charged for your first patient on the first tooth, but by the time you hit the third tooth? Radiometers, friends. Measure.

DR. A:
Exactly. It amazes me what people look for bargains in. Some things I can understand. You want to get a bargain in plastic covering for the headrest? Fine, look for a bargain. But to find a bargain in a curing light, which

is 80% of your dentistry? And you want to get the $300 light as opposed to the one that's really tested? I don't think so.

DR. R:
Yeah. So, this is going to be a shout out to all the startup Facebook groups where everybody starts talking about, "Save money here, save money there. You can always buy better later." There are places you can save money. And then there are places where you can't save. Remember the damned oath you signed when you crossed the stage, friends, and live up to that autograph that you put on the paper.

DR. MM:
One thing you can't save later is your reputation. I know there's lots of codes of conduct that I live by, but one that hasn't served me poorly is, I like to not be annoyed. I like to use composites that handle the way I like them to handle, which is obviously different than others out there. Everybody's different.

I don't like patients coming back saying that their teeth are sensitive. I don't like my hygienist to take bite wings and my bite wings on my restorations look poor. I like everything I do to be as predictable as possible. Obviously things come up, but there are ways we can mitigate those risks. Using quality materials and quality instruments, quality curing lights, is only going to contribute to that success.

DR. R:
One hundred percent. And coming full circle—Peter, you were talking about SmileFast—we don't need to compromise on the quality. We just need to get innovative and continue to find ways to streamline our time. For goodness sakes, that's the most valuable commodity we have. So we can figure out how to do four, six, eight composite veneers in an hour instead of four, I can't think of a better way to deliver excellence without compromise to our patients' well-being.

DR. A:
Well, that's one of the reasons that I like the Monet light. There are a couple of negatives there, because it's a laser. You have to wear laser glasses. It means you have to be prepared for all of that stuff. But it's now proving to cure composites in one second. Not all composites, but most composites—one, at the most, three. You know how crazy all of us are, we will always cure it longer than we're supposed to just because that's who we are. So if it's a 10-second cure, I'm going to cure it for 20. If it's a 20-second cure, I'll do it for 40. If it's a 1-second cure, I don't mind doing it to 2. I'll do 3. If you want to scrimp on something, or you want to do something that's going to help things go faster, that works for me as long as it works and it does.

DR. MM:
We only have a couple of minutes left, but I think that there's a lot of great materials out there. There's a lot of great products, but I think at the end of the day, sometimes we just need to train our hands and have a different perspective. You mentioned SmileFast, but where else can we get education that we can rely on to up our own games if that's what we want to do?

DR. A:
The places that were around years ago are still great. Pankey is a wonderful place to learn, and they've kind of transformed themselves over the last 10 years. Dawson has all new people over the last five years since Pete died. Still a great place to learn. Spear is wonderful. Seattle study clubs are wonderful. There are some fabulous speakers out. If you're looking at composite dentistry, Adamo Notarantonio is just mind-boggling.

And the ACD, of course. And the ASDA, if you're not familiar with the ASDA, it's an organization that's been around for a while. It's a place where you feel like you meet friends every time. It's marvelous. If you've ever been to one of their meetings, they cuddle you the minute you go there, which is a little different than some of the bigger institutes out there. And if you want to learn about digital dentistry this year, digital wax-ups, that sort of thing, almost their whole meeting is about that this year. It's in October.

So there are wonderful places to learn and that's what changed my life in dentistry. As I mentioned last time, I spent several years at Dawson and then the last 10 at the AACD, and that's how I learned to be a dentist who I'm proud of.

DR. R:
That's awesome. It's fun to come full circle on these things and see where our path took us. But we started with composite dentistry and "is Instagram a reality?" and I think what I'm hearing from this conversation today is lots of times no, but it can be if we engage the right people going to get that good training, if we work with the right products, and if we build in the right process in our practices. We're very capable of delivering Instagram-worthy composite dentistry, but it's going to take those ingredients. How about you, Pam?

DR. MM:
I think that there are other ways to seek professional fulfillment. And I think that if you do the type of work that lasts a long time and you treat your patients fairly and well and comfortably and reliably, I find that to be all the warm fuzzies I need. Although I'm going to check out the ASDA for a snuggle.

Maybe we should really rethink our priorities and our online presence. I mean, there's other ways to be genuine. If you're Photoshopping your composites to get likes, chances are there are other things that you could be doing to use your time more wisely.

DR. A:
One thing I tell patients who are moving to another area who ask for the name of a dentist is check their website, find out what kind of training they've been to. And I will actually tell the patients the names of the places that I just talked to you about. Because that dentist that was posting thousands of crazy things from that part of California, I took a look and there is nothing there about any cosmetic dentistry organization, which I find kind of shocking. That's not the stuff you're just going to learn from dental school

DR. R:
Or YouTube.

DR. MM:
Alright, well, we are out of time. I can't wait to see you again next month. I'd like to thank Tokuyama, our sponsor for this episode, and I just can't thank you enough for all your insights and your candor.

DR. R:
Thank you everyone for watching or listening to the show this week. And thanks to our guests and sponsors on this episode.

DR. MM:
Please check out our social media: @drpamela_maragliano and @dentaleconomicsofficial.

DR. R:
Or you can check me out @ignitedds or @drdavidrice.

DR. MM:
And go to dentaleconomics.com to subscribe to Dental Economics. You can choose to receive DE in print or digitally.

DR. R:
If you have topics or guests or anything you'd like to talk about on the show, send us an email to dentistryunmaskedpodcast@gmail.com and we will do our very best to make it happen.

Listen to Dentistry Unmasked wherever you get your podcasts.

Pamela Maragliano-Muniz, DMD, is the chief editor of DentistryIQ and editorial co-director of Through the Loupes. Based in Salem, Massachusetts, Dr. Maragliano-Muniz began her clinical career as a dental hygienist. She went on to attend Tufts University School of Dental Medicine, where she earned her doctorate in dental medicine. She then attended the University of California, Los Angeles, School of Dental Medicine, where she became board-certified in prosthodontics. Dr. Maragliano-Muniz owns a private practice, Salem Dental Arts, and lectures on a variety of clinical topics. You may contact her at pmuniz@endeavorb2b.com.

As seen on The Doctors, **David R. Rice, DDS,** chief editor of DentistryIQ and founder of igniteDDS, the nation's largest new dentist and student community, travels the world speaking, writing, and connecting today's top young dentists with tomorrow's most successful dental practices. He leads a team-centered, restorative and implant practice in East Amherst, New York. With 28 years of practice in the books, he's trained at the Pankey Institute, the Dawson Academy, Spear Education, and most prolifically, at the school of hard knocks.

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

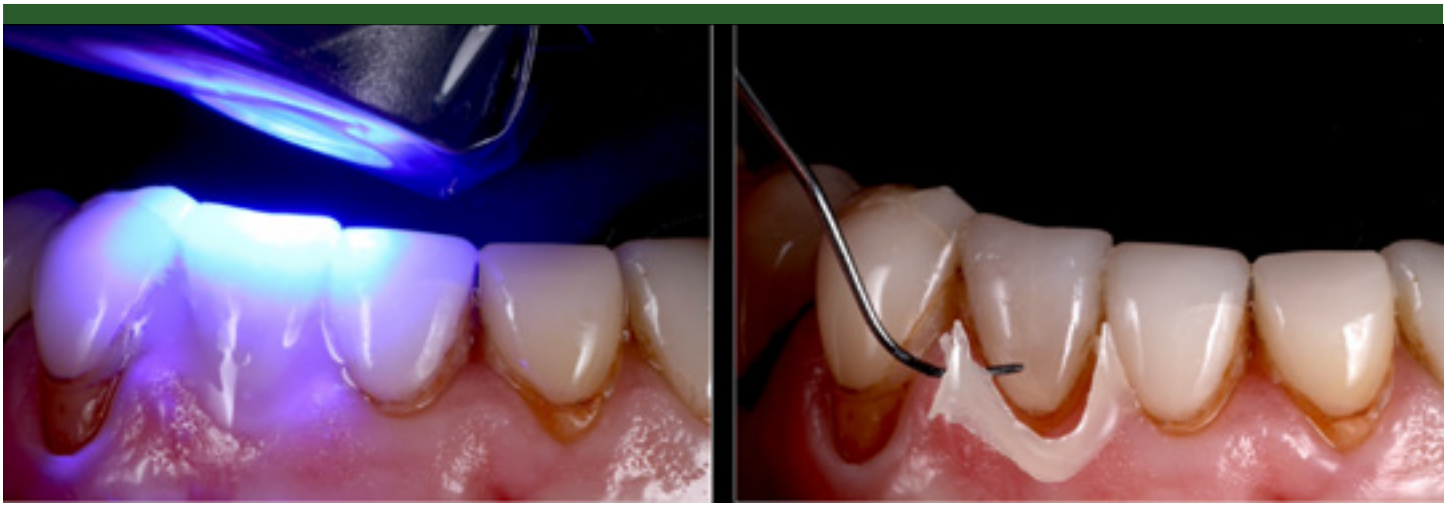
PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

Peter Auster, DMD, has 30 years of experience in high-quality dentistry in his private practice in Pomona, New York. Dr. Auster completed two terms on the board of directors of the AACD and is proud of his selection as the AACD 2015 Humanitarian of the Year. He currently chairs the AACD Leadership Committee. He is founder and past-president of the New York Affiliate of the AACD, the Greater New York Academy of Cosmetic Dentistry. He is a Dawson Scholar and received a Concept of Complete Dentistry Award from the Dawson Academy.

CLINICAL CASE STUDIES: A STREAMLINED DENTAL CEMENTATION PROTOCOL FOR LOW-RETENTION RESTORATIONS

Dr. Miles Cone explains how the use of self-adhesive cements in combination with a unique adhesive enhancing primer can aid in predictable delivery of many types of indirect restorations with limited tooth structure.

BY MILES R. CONE, DMD, MS, CDT, FACP



Indirect restorations, including porcelain veneers, crowns, and fixed dental prosthetics (FDPs), have endured with great success as one the most prevalent modalities for individuals seeking to correct functional and cosmetic intraoral conditions.[1] Resistance to dislodgment remains a key objective for full-coverage tooth preparations;[2] however, the frequently encountered overreduction of tooth structure when replacing existing dental restorations presents less-than-ideal situations in obtaining maximum retention. Achieving clinical success when presented with limited natural tooth anatomy may be aided by self-adhesive resin cements (SACs). These bonding agents combine the benefits of additional working time with the mechanical properties of light-cure and chemical-cure resin cements.[3] The high bond strength, fracture toughness, low solubility, and simplified application protocols of

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

contemporary SACs makes their utilization in the cementation of compromised indirect restorations an appealing treatment option for clinicians.[4]

The gamut of currently available SACs on the market may pose a daunting decision-making task for the practitioner.[5] To address the practical need for a streamlined material inventory and simplified cementation protocol, a newly developed SAC and accompanying Adhesive Enhancing Primer (G CEM One + AEP, GC America) were developed. The following four case studies demonstrate the variety of day-to-day applications this novel SAC/primer combination possesses for a variety of indirect restorations in wide-ranging clinical scenarios.

CASE NO. 1: EMERGENCY RECEMENTATION OF DEBONDED FELDSPATHIC VENEER

A 67-year-old female presented for emergency care regarding a dislodged feldspathic veneer on tooth no. 27. An intraoral examination revealed that the veneer had fully debonded with no fracture to the restoration, and an aggressively prepared mandibular right canine was devoid of enamel.

In the laboratory, the debonded veneer was subjected to air-particle abrasion with 50µ aluminum oxide (Cobra, Renfert), thoroughly steam-cleaned, and the intaglio surface was etched with 9.5% hydrofluoric acid (HF) for two minutes (Porcelain Etchant, Bisco Canada). Following standardized cleaning protocols, a silane bonding agent (Silane, Ultradent) was applied to the intaglio surface of the veneer for one minute and then allowed to evaporate under a warm hair dryer.[6] The exposed tooth preparation was coated with an AEP on a microbrush for 10

Figure 1: Adhesive Enhancing Primer (AEP) applied to tooth preparation with a microbrush

Figure 2: a: Light-curing excess cement to allow for b: removal of excess cement

seconds and then air-dried for five seconds (figure 1). The accompanying SAC was then used to bond the porcelain veneer. An accelerator in the AEP placed on the tooth surface instantly reacts with a chemical initiator in the cement to enhance and expedite the curing capacity of the resin—a process the manufacturer refers to as Touch Cure Technology. The extruded resin cement (figure 2a) was then tack-cured at the margins for one second to allow for easy removal of excess cement and cleanup (figure 2b). Light-curing was continued circumferentially around the tooth for approximately 60 seconds. No occlusal adjustment was necessary; the patient was satisfied with the repair and dismissed without issue.

CASE NO 2: FULL-COVERAGE LITHIUM DISILICATE CROWN

A 42-year-old male presented for emergency care with an existing feldspathic veneer on the upper right lateral incisor that fractured unexpectedly. The intraoral examination revealed a short underlying clinical crown with no remaining enamel, and the mesial portion of the ceramic veneer was still attached (figure 3). The treatment plan for the patient involved preparation of the tooth for a full-coverage lithium disilicate crown. At the delivery appointment, the patient's provisional crown was removed, and the tooth preparation was gently scrubbed with a 2% chlorhexidine gluconate pumice (Consepsis, Ultradent) and rinsed. The laboratory and chairside protocols for the etching, cleaning, and silanating of the lithium disilicate crown were identical to the previous case, with the exception of the intaglio surface of the crown being etched for only 20 seconds with HF rather than two minutes. The same AEP, cementation, and light-curing steps were also followed in accordance with the recommended manufacturer's instructions described in the first case. The patient's occlusion was evaluated without need for adjustment. The patient was satisfied with the final esthetic outcome (figure 4) and dismissed without issue.

Figure 3: Fractured feldspathic veneer with limited hard tissue anatomy

Figure 4: Adhesively bonded lithium disilicate restoration (LiSi Press, GC America)

CASE NO. 3: CAST-GOLD ONLAY

A 55-year-old male presented with a fractured restoration and recurrent decay under tooth no. 13. The patient has a history of bruxism coupled with extrinsic dietary chemical erosion. A treatment plan was made to replace the failing amalgam with a partial-coverage cast-gold onlay, which would aid in the preservation of tooth structure and provide a good long-term prognosis. Metal-ceramic crowns and restorations composed of cast-metal alloys are unable to form a true chemical bond with the underlying tooth structure; therefore, the type of cement used for the retention of metal crowns is critical to ensure clinical success.[7]

Figure 5: a: Onlay preparation tooth no. 13 for cast-gold restoration, b: final result of cast-gold onlay tooth no. 13

All existing restorative material and recurrent decay were removed from tooth no. 13. The axial walls and pulpal floor of no. 13 were then refined with fine diamond burs in a high-speed handpiece to ensure a single path of draw and to maximize retention for the definitive cast-gold restoration (figure 5). To ensure maximum adhesion of the resin cement to the underlying tooth structure, an identical protocol was followed from the previous case studies in which an SAC was used in conjunction with an AEP. Following delivery of the cast-gold restoration, the patient's occlusion was evaluated, and all adjustments were made with rubber polishing points. The patient was satisfied with the fit and function of the final restoration and dismissed without issue.

CASE NO. 4: THREE-UNIT LAYERED ZIRCONIA FDP

A 38-year-old female presented with a dislodged three-unit zirconia FDP. An intraoral examination revealed that the ceramic abutment for tooth no. 6 was not seated on the underlying preparation, and recurrent decay was present on the lingual margin of tooth no. 8 (figure 6). A treatment plan was devised to include sectioning and removal of the existing FDP and replacement with a new three-unit layered zirconia restoration. Fixed multiunit prosthetics present a different restorative challenge than stand-alone crowns and veneers. Each abutment must have enough

taper to allow for a passive, single path of draw of the rigid framework. However, overreduction of the individual teeth is common (figure 7),[8] the retention is compromised,[9] and an exposure of the underlying vital pulp may occur, necessitating endodontic therapy. The recommended protocol was followed for pretreating zirconia frameworks with air-particle abrasion utilizing aluminum oxide, decontamination with commercial cleansers (ZirClean, Bisco Canada),[10] followed by cementation with an SAC containing MDP.[11] Prior to cementation, an AEP was again applied to each abutment tooth in an identical protocol to each of the previous case studies. Following delivery of the final restoration, the patient's occlusion was evaluated, and no adjustments were necessary. The function and esthetics of the new three-unit FDP were deemed acceptable, and the patient was very satisfied with the final result (figure 8).

Figure 6: (top) Occlusal view of debonded abutment tooth no. 6, and recurrent decay on abutment tooth no. 8

Figure 7: (bottom) Try-in of layered zirconia FDP demonstrating overprepared tooth structure

Figure 8: Definitive layered zirconia FDP demonstrating improved overall esthetics

CONCLUSION

These four case studies have demonstrated that the use of SACs in combination with a unique AEP can aid in the predictable delivery of many types of indirect restorations with limited tooth structure by providing the following clinical advantages: reduced need for fricative macroretention,[12] avoidance of composite buildups, and elimination of unnecessary endodontic therapy for post and core placement.[13]

Clinicians who choose to utilize SACs in their clinical practice will appreciate the ease of application and cleanup as well as a peace of mind in knowing that a strong, reliable bond with reduced microleakage[14] and high retention has been achieved for their patients.[15]

REFERENCES

[1]Vinnakota DN. Effect of preparation convergence on retention of multiple unit restorations – An *in vitro* study. *Contemp Clinc Dent.* 2015;6(3):409-413.

[2]Blair FM, Wassell RW, Steele JG. Crowns and other extra-coronal restorations: Preparations for full-veneer crowns. *Br Dent J.* 2002;192(10):561-564, 567-571.

[3]Mendes M, França FMG, Basting RT, Turssi CP, do Amaral FLB. Long-term bond strength of fiber posts cemented to dentin with self-adhesive or conventional resin cements. *J Adhes Sci Technol.* 2017;31(9):977-987.

[4]Ferreìra-Filho R, Ely C, Amaral R, et al. Effect of different adhesive systems used for immediate dentin sealing on bond strength of a self-adhesive resin cement to dentin. *Oper Dent.* 2018;43(4):391-397.

[5]Borges MHR, Barroso CG, Dias T, Alencar C de M, Silva CM, Esteves, RA. Evaluation of physical-mechanical properties of self-adhesive versus conventional resin cements. *Braz J Oral Sci.* 2020;19(1):e208204.

[6]Campos F, Almeida CS, Rippe MP, de Melo RM, Valandro LF, Bottino MA. Resin bonding to a hybrid ceramic: effects of surface treatments and aging. *Oper Dent*. 2016;41(2):171-178.

[7]Ady AB, Fairhurst CW. Bond strength of two types of cement to gold casting alloy. *J Prosthet Dent.* 1973;29(21):217-223. doi:10.1016/0022-3913(73)90116-9

[8]Norlander J, Weir D, Stoffer W, Ochi S. The taper of clinical preparations for fixed prosthodontics. *J Prosthet Dent.* 1988;60(2):148-151. doi:10.1016/0022-3913(88)90304-6

[9]Principles of tooth preparation. In: Shillinburg HT, Hobo S, Whitsett LD, Jacobi R, Brackett SE, eds. *Fundamentals of Fixed Prosthodontics.* 3rd ed. Quintessence. 1997;335-353.

[10]Della Bona A, Northeast SE. Shear bond strength of resin bonded ceramic after different try-in procedures. *J Dent.* 1994;22(2):103-107. doi:10.1016/0300-5712(94)90012-4

[11]Yun J-Y, Ha S-R, Lee J-B, Kim S-H. Effect of sandblasting and various metal primers on the shear bond strength of resin cement to Y-TZP ceramic. *Dent Mater.* 2010;26(7):650-658. doi:10.1016/j.dental.2010.03.008

[12]Burke FJT. Fracture resistance of teeth restored with dentin-bonded crowns: The effect of increased tooth preparations. *Quintessence Int.* 1996;27(2):115-121.

[13]Bindl A, Richter B, Mörmann WH. Survival of ceramic computer-aided design/manufacturing crowns bonded to preparations with reduced macroretention geometry. *Int J Prosthodont.* 2005;18(3):219-224.

[14]Sorensen JA, Kang SK, Avera SP. Porcelain-composite interface microleakage with various porcelain surface treatments. *Dent Mater.* 1991;7(2):118-123.

[15]el-Mowafy O. The use of resin cements in restorative dentistry to overcome retention problems. *J Can Dent Assoc.* 2001;67(2):97-102.

Miles R. Cone, DMD, MS, CDT, FACP, a graduate of Tufts University School of Dental Medicine, completed a three-year prosthodontic residency program while serving in the US Army. He later earned his designation as a certified dental technician. Dr. Cone is the owner of Nuance Dental Specialists, a private practice dental clinic limited to prosthetic dentistry in Portland, Maine, and a key opinion leader and educator for GC America. An international lecturer, he has been published extensively in peer-reviewed journals.

CHOOSING BETWEEN COMPLETE (CROWN) OR PARTIAL COVERAGE (INLAY AND ONLAY) RESTORATIONS: WHAT WILL LAST?

Based on the amount of remaining tooth structure, a clinician can choose between complete or partial coverage. Here's an analysis of the survival and loss of tooth vitality when making that choice.

BY KENNETH A. MALAMENT, DDS, MSCD, AND MARIAM MARGVELASHVILI-MALAMENT, DMD, PHD, MSC

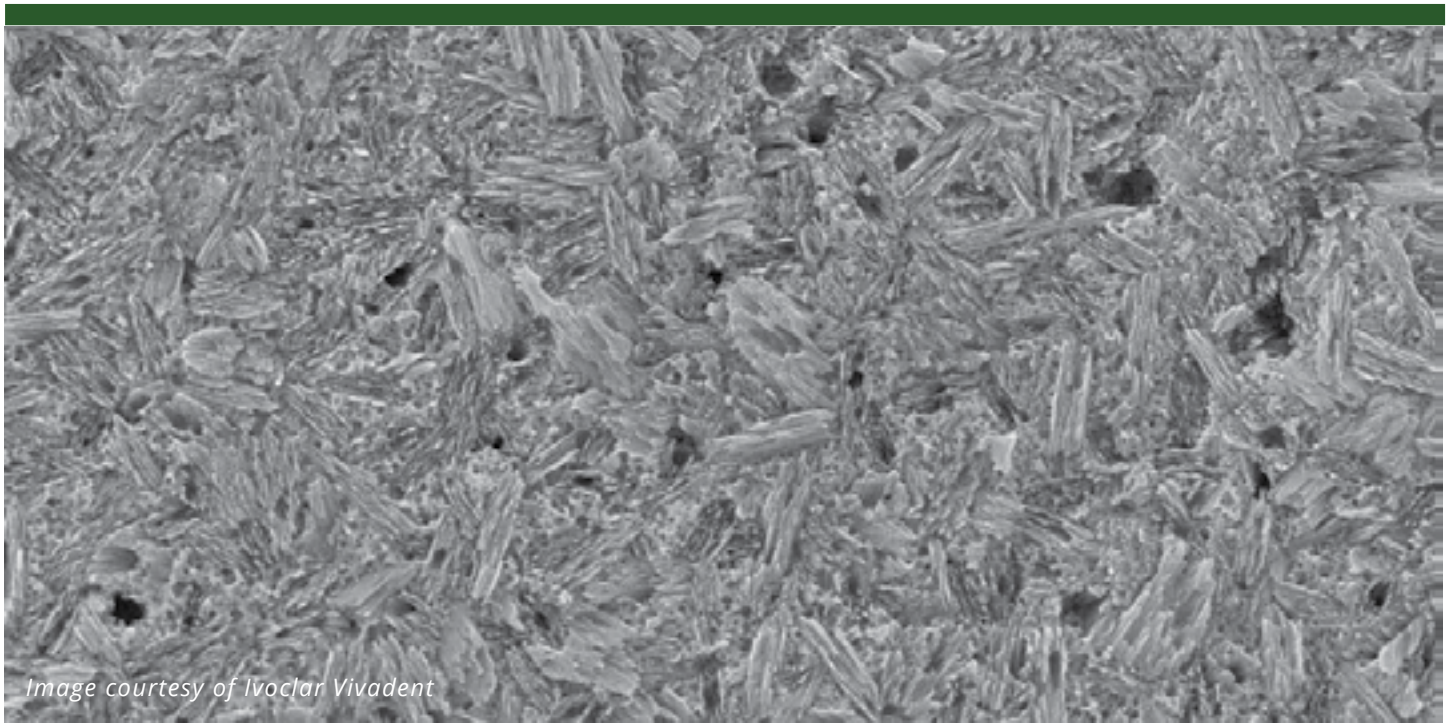


Image courtesy of Ivoclar Vivadent

There is significant increase in life expectancy and in the number of retained natural teeth at an older age.[1,2] Although preventive dentistry is widely practiced, dental caries remains a prevalent oral disease, causing irreversible loss of tooth structure. Tooth structure loss through attrition, abrasion, erosion, or combination of these is also persisting among the world population.[3-5]

In a very simplified sense, restorative dentistry aims to remove decayed dental tissues and restore what is lost with a material

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

to replicate its shape, shade, and function. Based on the amount of remaining tooth structure, a clinician can choose between complete (crown) or a partial coverage (inlay or onlay) restoration.[1,6,7]

Preparations for complete coverage restorations are more invasive,[8] and because the tooth can have large failing restorations and decay, there is widespread opinion that complete coverage restorations result in higher number of loss of tooth vitality.[8] Thus, over many years, restorative dentistry has favored minimally invasive procedures to preserve as much tooth structure as possible. Thus modern dentistry is shifting toward partial coverage restorations even in the teeth that require lingual, occlusal, and buccal coverage restorations.[9,10] Partial coverage restorations are indeed more conservative due to the nature of the preparation and the path of insertion.[8]

Teeth have become a sign of social status, and patients request tooth-colored restorations. This drive for more natural-looking materials has led the industry to move away from gold and other precious metals. In fact, a dentist is faced with many resin and ceramic products, making it difficult to decide which material to choose for a clinical situation.[11]

Lithium disilicate was introduced to the dental market in the early 2000s as IPS e.max Press (Ivoclar Vivadent) and has become a popular material for anterior restorations, combining excellent esthetics with acceptable mechanical properties.[12] However, its flexural strength of 470 MPa and fracture toughness of 2.54 MPa have led to questioning the use of lithium disilicate restorations in the posterior region,[13] where occlusal loads are higher[14] and where materials with higher flexural strength and fracture toughness such as monolithic zirconia have been preferred.[15,16]

Moreover, there is a widespread assumption that e.max lithium disilicate glass ceramic with a thickness less than 1 mm is more susceptible to catastrophic fracture,[17] which leads to more invasive tooth preparations or avoidance of the material.

Which type of glass ceramic restoration in the posterior dentition, complete or partial, performs better over a long time remains unanswered. There is also no evidence-based answer for the question of which type of restoration, complete or partial, results in higher incidence in the need for endodontic therapy.

Therefore, we performed a prospective clinical study with twofold aim:

1. To compare long-term clinical survival and the clinical factors influencing the outcomes of adhesively bonded e.max lithium disilicate glass ceramic complete and partial coverage restorations, and to evaluate the performance of e.max lithium disilicate glass ceramic restorations in the posterior teeth.
2. To assess the incidence of teeth requiring endodontic therapy after receiving either a complete or a partial coverage glass ceramic restoration with up to 36 years of follow-up.

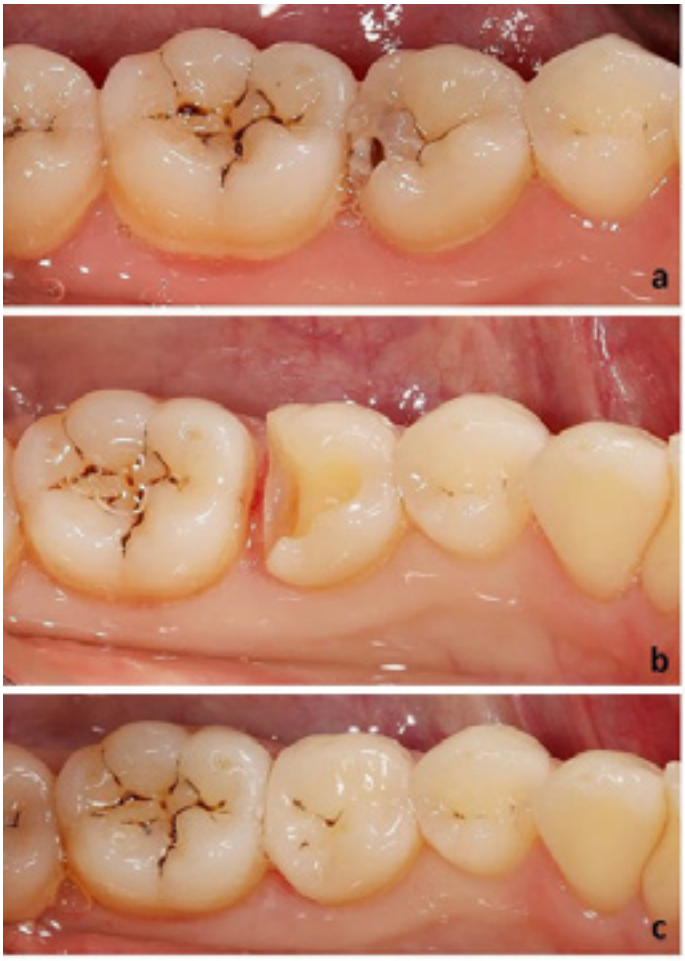
The prospective study was initiated in 1985 and the database parameters as well as the recall method were adopted from previously published studies of the same group of researchers.[18-25] Clinical confounding variables evaluated were: dental arch, tooth position in

the dental arch, age and sex of participant, ceramic thickness, and type of restoration.

We are sharing our scientific findings to help clinicians in decision-making and provide evidence-based answers when choosing restorations and materials.

THE EXPERIMENTAL METHOD

Case 1: A clinical case of e.max lithium disilicate glass ceramic partial coverage restoration. (A) caries present in a mandibular premolar. (B) Preparation for a partial coverage restoration. (C) e.max lithium disilicate glass ceramic partial coverage restoration adhesively bonded.



Participants requiring single-unit, defect-specific, posterior partial coverage restoration; single-unit anterior or posterior complete coverage restoration; or a combination were recruited in a clinical private practice. Only the participants who chose glass ceramic restorations were included in the current study.

Participants in this study were at least 20 years of age and had demonstrated full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS) 25%. Teeth included in the study had adequate periodontal support; no or limited mobility; and adequate remaining tooth structure for the choice of a single-unit, defect-specific, partial or complete coverage restoration; and had to be vital.

The decision as to which type of glass ceramic restoration (complete or partial coverage) considered the extent of damage, presence of fracture lines, and resistance and retention form.[6,7]

For partial coverage restorations, defect-specific tooth preparations removed all the caries and created proper retention form. Inlay or onlay partial coverage preparation design was then chosen based on the remaining tooth structure.1 The complete coverage restorations were approximately 1.2 mm in depth, and marginal finishing burs were employed.

Restorations were completed in a conventional manner utilizing medium body polyether (Impregum, 3M ESPE) impression material. Lost-wax technique and a glass ceramic pressing system were then used to fabricate the definitive restorations.

THE RESTORATIONS

After clinical evaluation and necessary adjustment, all restorations were etched (4.5% buffered hydrofluoric acid, IPS Ceramic Etching Gel; Ivoclar Vivadent) for 20 seconds, and silane (Monobond Plus; Ivoclar Vivadent) was applied for 60 seconds. The teeth were etched with 38% phosphoric acid (Etch-Rite; Pulpdent), coated with a desensitizer (Gluma Desensitizer; Kulzer), and dentin bonded (Excite; Ivoclar Vivadent). The restorations were adhesively luted with a light-polymerizing resin (Variolink II; Ivoclar Vivadent) activated with an LED polymerization light (Bluephase Style; Ivoclar Vivadent). All the excess cement was removed thoroughly.

Prior to cementation, the following parameters were entered or determined: type of ceramics, type of restoration, restoration thickness measured by calipers at up to seven points (mesial, distal, buccal, lingual, mesial-occlusal, midocclusal, distal-occlusal), tooth position, age and sex of the patient. The restorations with at least one of the above-described measurement points less than 1 mm were grouped in the thickness of less than 1 mm.

The participants were routinely recalled every six months. The status of the restoration(s) was evaluated, and the incidence of postprosthetic root canal therapy was assessed.

THE RESULTS

Case 2: A clinical case of e.max lithium disilicate glass ceramic partial coverage restorations as a part of complex full-mouth reconstruction. (A) Preparation for partial coverage restorations on maxillary molars and premolars. (B) e.max lithium disilicate glass ceramic partial coverage restorations adhesively bonded.

Data collection began in 1985 and was truncated for this analysis after almost 36 years in 2020. The study included 1,534 participants and 6,683 units, of which 3,496 were posterior complete, 1,007 posterior partial, and 2,180 anterior complete coverage restorations. Out of 1,534 participants, 609 were men and 925 were women. The mean age of the participant at the time of restoration placement was 62 with a range of 20 to 99 years.

CUMULATIVE SURVIVAL

The clinical performance of 6,683 units up to 36 years was excellent, with the estimated cumulative survival of 96.35%.There were 84 biological failures (defined as tooth needing postprosthetic endodontic therapy) recorded, out of which 61 occurred in posterior complete,

12 in posterior partial, and 11 in anterior complete coverage restorations, providing a crude estimate of an annual percentage of biological failures of 0.16% with the survivor function time at 35.6 years. The incidence of 84 endodontic therapies occurred during a cumulative monitoring period of 51,564 years, with an overall survival rate of 96.35%.

Case 3: A clinical case of e.max lithium disilicate glass ceramic partial coverage restoration bulk fracture.

POSTERIOR VS. ANTERIOR

Posterior complete coverage restorations had statistically significant higher biological failure rate than anterior. The overall clinical performance of posterior complete coverage restorations relative to biological failure was still high with a cumulative survival of 95.15% over 35 years.

POSTERIOR COMPLETE VS. PARTIAL COVERAGE

There was no difference in biological failure rate between posterior complete and partial coverage restorations. First and second molars had the highest rate of postprosthetic endodontic therapy in both arches.

FAILURE RATE BY SEX

Case 4: A clinical case of e.max lithium disilicate glass ceramic complete coverage restorations as a part of complex full-mouth reconstruction. (A) Anterior view of a severe wear case before treatment. (B) During treatment after complete preparations. (C) e.max lithium disilicate glass ceramic complete coverage restorations adhesively bonded.

There was no difference in biological failure rate between men and women. There was no statistically significant difference in survivor function for total restorations, or complete and partial coverage restorations, between men and women.

FAILURE RATE BY AGE

There was no difference in biological failure rate of different age groups.

TIME TO FAILURE

The survival of 2,392 posterior e.max lithium disilicate complete and partial coverage restorations placed in 738 participants was evaluated at 17 years. Only 22 failures were recorded with a 16-year cumulative survival of 96%.

The average time to failure was 3.5 years. No debonded restorations were recorded. The majority of failures (77%) occurred within 6 years. There were no failures beyond 8 years of service.

TYPE OF BONDING

The data indicated that acid etched and adhesively bonded monolithic IPS e.max pressed lithium disilicate complete (97%) and partial (95%) coverage restorations exhibited excellent survival in the posterior teeth.

COMPLETE VS. PARTIAL

No statistically significant difference was found between complete and partial coverage restorations.

Clinicians widely use complete coverage restorations, especially in the posterior dentition.[26] However, the opinion leaders in the dental community are becoming more critical of the preparation protocols needed for these restorations.[27,28] Quantification of preparation types showed a 68% to 76% removal of tooth structure for complete coverage restorations, which is significantly more than the amount removed for partial coverage restorations.[8]

Other concerns associated with crown preparation were postprosthetic need for endodontic therapy, weakening of the tooth, catastrophic root fracture, and finally, the need for extraction.[7,29] In contrast, indirect partial coverage restorations can offer a minimally invasive treatment procedure with reliable occlusal schemes.[30]

Although the difference was not statistically significant, neither in survival rates nor in the need of endodontic therapy, it provides scientific evidence for encouraging clinicians to use partial coverage restorations in the posterior teeth given that remaining tooth structure is adequate. This is opposed to always leaning toward complete coverage restorations, which, in some respect, is still considered to be a gold standard among clinicians.

However, this should not serve as an encouragement for fabricating partial coverage restorations where they're not indicated.

The newer dental trend entails insertion of two restorations (buccal and lingual) for a single tooth. Although, some studies have been published using this technique, their number of patients and units is very small and follow-up time is shorter.[9,10]

If a tooth requires buccal, occlusal, and lingual coverage restorations, it is more convenient and financially feasible to fabricate single complete coverage restoration. Because there is no difference in the survival or loss of tooth vitality, complete coverage restorations should not be neglected. For a tooth that has significant loss of tooth structure, or requires restoration of several surfaces due to severe wear, a crown is a well-validated treatment modality.

THE ROLE OF MATERIALS

Ceramic materials have evolved dramatically over the last two decades,[11] with so many ceramic materials that choice is based on personal preference and opinion, rather than evidence. One such widely spread opinion-based assumption is to avoid the use of lithium disilicate in posterior dentition due to high occlusal loads that could lead to premature fractures. In 2,392 posterior restorations studied over 17 years, only 22 fractures were recorded. Most failures occurred within the first 6 years and then declined, with five additional failures at 8 years. There were no additional failures in the 236 restorations with time in service of from 8 to 17 years. This

declining failure rate suggests a lack of fatigue degradation in these longer-term restorations and will be explored in a future publication.

Of the 22 failures, 18 occurred in the molar region, and no debonding was seen. Our group has previously reported that Dicor glass ceramic has a higher risk of fracture in the molar region. Although there is also a trend of higher failure in the molar region for the lithium disilicate, no statistical significance was yielded. Even for the mandibular second molars that showed the highest failure rate (six failures), the estimated annual risk of failure was only 0.4% and without statistical significance. This provides evidence for choosing lithium disilicate for the molar region.

INFLUENCE OF THICKNESS

Thickness of ceramic material had no influence on the incidence of biologic failures in posterior complete, posterior partial, and anterior complete coverage restorations. Restorations with surfaces less than 1 mm and greater than or equal to 1 mm performed similarly over 17 years.

Another widely spread but clinically unsupported opinion is to avoid using lithium disilicate with thickness greater than 1 mm.[31,32] This recommendation translates into removing additional tooth structure to create the desired greater than or equal to1 mm clearance.

In the current study, the variable of thickness had no effect on the survival of complete and partial coverage restorations in the posterior teeth. The restorations with at least one surface with a thickness less than 1 mm performed similarly to those with a thickness of 1 mm or more. Similar findings have also been reported in clinical and in vitro studies.

The lack of influence of the restoration thickness can be explained by the adhesive luting protocol used for both complete and partial coverage restorations in the present study. It is well established that the mechanical properties of ceramics increase with adhesion, which explains the findings in a series of studies.[20,27,28,33,34]

These findings should encourage clinicians to be less invasive during preparation and minimize the clearance required for e.max lithium disilicate glass ceramic restorations to save as much of the tooth structure as possible.

INFLUENCE OF COVARIATES

Covariates such as tooth position, sex, and age demonstrated no effect on survival.

Both age and sex are considered confounding variables in medical and dental studies, as they entail factors such as occlusal force, oral hygiene, and diet.[35]

In our studies, the assessment of age and sex as confounding variables was completed, and no significant effect on survival was recorded. This provides scientific and clinical evidence for choosing lithium disilicate glass ceramic complete and partial coverage restorations in male and female patients regardless of age.

CONCLUSION

Lithium disilicate is an etchable glass ceramic, and a strong micromechanical bonding to tooth structure is developed,[11] resulting in improved physical properties of the restoration.[36,37] In the present study, all the restorations were adhesively luted by using the dentin bonding agent followed by the adhesive cement Variolink. This may explain

the higher overall survival rate of over 96% and the fact that no restoration debonded over this observation time.

The low rate of loss of tooth vitality may be attributed to the adhesive cementation protocol used. Phosphoric acid etching of the abutment teeth removes smear layer and bacteria. Dentin sealing using Gluma, followed by a dentin bonding agent and resin cement, results in a reliable seal that could prevent bacterial leakage and possible contamination and micromotion between the core substrate (dentin and/or enamel) and ceramics.

Each patient has an individual clinical scenario with varying health conditions and remaining tooth structure. Therefore, it is important that restorative dentists make an evidence-based selection of material and treatment method. We hope to have provided evidence-based answers to these everyday clinical questions.

Editor's note: For more details on this study, access the full-length paper at dentaleconomics.com/malament.

REFERENCES

[1] The glossary of prosthodontic terms: ninth edition. *J Prosthet Dent*. 2017;117(5S):e1-e105. doi:10.1016/j.prosdent.2016.12.001

[2] Frencken JE, Sharma P, Stenhouse L, Green D, Laverty D, Dietrich T. Global epidemiology of dental caries and severe periodontitis - a comprehensive review. *J Clin Periodontol*. 2017;44(Suppl 18):S94-S105. doi:10.1111/jcpe.12677

[3] de Melo MA, Passos VF, Lima JP, Parente GC, Rodrigues LK, Santiago SL. Erosive potential of processed and fresh orange juice on human enamel. *J Dent Child (Chic)*. 2015;82(1):10-15.

[4] Hattab FN, Yassin OM. Etiology and diagnosis of tooth wear: a literature review and presentation of selected cases. *Int J Prosthodont.* 2000;13(2):101-107.

[5] Maher RL, Hanlon J, Hajjar ER. Clinical consequences of polypharmacy in elderly. *Expert Opin Drug Saf*. 2014;13(1):57-65.

[6] Goodacre CJ, Campagni WV, Aquilino SA. Tooth preparations for complete crowns: an art form based on scientific principles. *J Prosthet Dent*. 2001;85(4):363-376.

[7] Goodacre CJ, Spolnik KJ. The prosthodontic management of endodontically treated teeth: a literature review. Part I. Success and failure data, treatment concepts. *J Prosthodont*. 1994;3(4):243-250.

[8] Edelhoff D, Sorensen JA. Tooth structure removal associated with various preparation designs for posterior teeth. *Int J Periodontics Restorative Dent.* 2002;22(3):241-249.

[9] Mainjot AKJ. The one-step no-prep technique: a straightforward and minimally invasive approach for full-mouth rehabilitation of worn dentition using polymer-infiltrated ceramic network (PICN) CAD-CAM prostheses. *J Esthet Restor Dent*. 2020;32(2):141-149.

[10] Oudkerk J, Eldafrawy M, Bekaert S, Grenade C, Vanheusden A, Mainjot A. The one-step no-prep approach for full-mouth rehabilitation of worn dentition using PICN CAD-CAM restorations: 2-yr results of a prospective clinical study. *J Dent.* 2020;92:103245. doi:10.1016/j.jdent.2019.103245

[11] Gracis S, Thompson VP, Ferencz JL, Silva NR, Bonfante EA. A new classification system for all-ceramic and ceramic-like restorative materials. *Int J Prosthodont*. 2015;28(3):227-235.

[12] Willard A, Gabriel Chu TM. The science and application of IPS e.Max dental ceramic. *Kaohsiung J Med Sci*. 2018;34(4):238-242.

[13] Alkadi L, Ruse ND. Fracture toughness of two lithium disilicate dental glass ceramics. *J Prosthet Dent*. 2016;116(4):591-596.

[14] Manns A, Rojas V, Van Diest N, Rojas D, Sobral C. Comparative study of molar and incisor bite forces regarding deciduous, mixed, and definitive dentition. *Cranio*. 2020:1-8.

[15] Blatz MB, Vonderheide M, Conejo J. The effect of resin bonding on long-term success of high-strength ceramics. *J Dent Res*. 2018;97(2):132-139.

[16] Ortorp A, Kihl ML, Carlsson GE. A 5-year retrospective study of survival of zirconia single crowns fitted in a private clinical setting. *J Dent*. 2012;40(6):527-530.

[17] Shahmoradi M, Wan B, Zhang Z, Wilson T, Swain M, Li Q. Monolithic crowns fracture analysis: The effect of material properties, cusp angle and crown thickness. *Dent Mater.* 2020;36(8):1038-1051.

[18] Malament KA, Margvelashvili-Malament M, Natto ZS, Thompson V, Rekow D, Att W. 10.9-year survival of pressed acid etched monolithic e.max lithium disilicate glass-ceramic partial coverage restorations: performance and outcomes as a function of tooth position, age, sex, and the type of partial coverage restoration (inlay or onlay). *J Prosthet Dent*. 2021;126(4):523-532. doi:10.1016/j.prosdent.2020.07.015

[19] Malament KA, Margvelashvili-Malament M, Natto ZS, Thompson V, Rekow D, Att W. Comparison of 16.9-year survival of pressed acid etched e.max lithium disilicate glass-ceramic complete and partial coverage restorations in posterior teeth: performance and outcomes as a function of tooth position, age, sex, and thickness of ceramic material. *J Prosthet Dent*. 2021;126(4):533-545. doi:10.1016/j.prosdent.2020.08.013

[20] Malament KA, Natto ZS, Thompson V, Rekow D, Eckert S, Weber HP. Ten-year survival of pressed, acid-etched e.max lithium disilicate monolithic and bilayered complete-coverage restorations: performance and outcomes as a function of tooth position and age. *J Prosthet Dent*. 2019;121(5):782-790. doi:10.1016/j.prosdent.2018.11.024

[21] Malament KA, Socransky SS. Survival of Dicor glass-ceramic dental restorations over 14 years: part II. Effect of thickness of Dicor material and design of tooth preparation. *J Prosthet Dent*. 1999;81(6):662-667.

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

[22] Malament KA, Socransky SS. Survival of Dicor glass-ceramic dental restorations over 14 years: part I. Survival of Dicor complete coverage restorations and effect of internal surface acid etching, tooth position, gender, and age. *J Prosthet Dent*. 1999;81(1):23-32.

[23] Malament KA, Socransky SS. Survival of Dicor glass-ceramic dental restorations over 16 years: part III. Effect of luting agent and tooth or tooth-substitute core structure. *J Prosthet Dent*. 2001;86(5):511-519.

[24] Malament KA, Socransky SS. Survival of Dicor glass-ceramic dental restorations over 20 years: part IV. The effects of combinations of variables. *Int J Prosthodont*. 2010;23(2):134-140.

[25] Malament KA, Socransky SS, Thompson V, Rekow D. Survival of glass-ceramic materials and involved clinical risk: variables affecting long-term survival. *Pract Proced Aesthet Dent.* 2003;(Suppl):5-11.

[26] Pjetursson BE, Lang NP. Prosthetic treatment planning on the basis of scientific evidence. *J Oral Rehabil*. 2008;35(Suppl 1):72-79.

[27] Edelhoff D, Guth JF, Erdelt K, Brix O, Liebermann A. Clinical performance of occlusal onlays made of lithium disilicate ceramic in patients with severe tooth wear up to 11 years. *Dent Mater.* 2019;35(9):1319-1330.

[28] Guess PC, Selz CF, Steinhart YN, Stampf S, Strub JR. Prospective clinical split-mouth study of pressed and CAD/CAM all-ceramic partial-coverage restorations: 7-year results. *Int J Prosthodont.* 2013;26(1):21-25.

[29] Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. *J Prosthet Dent*. 2003;90(1):31-41.

[30] Opdam N, Frankenberger R, Magne P. From 'direct versus indirect' toward an integrated restorative concept in the posterior dentition. *Oper Dent*. 2016;41(S7):S27-S34.

[31] Guess PC, Schultheis S, Wolkewitz M, Zhang Y, Strub JR. Influence of preparation design and ceramic thicknesses on fracture resistance and failure modes of premolar partial coverage restorations. *J Prosthet Dent*. 2013;110(4):264-273.

[32] Nordahl N, Vult von Steyern P, Larsson C. Fracture strength of ceramic monolithic crown systems of different thickness. *J Oral Sci.* 2015;57(3):255-261.

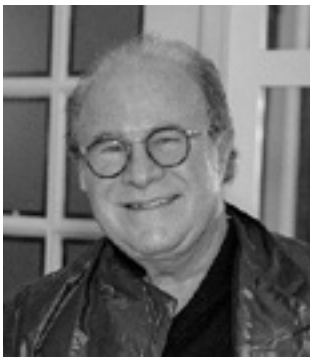
[33] Bakeman EM, Rego N, Chaiyabutr Y, Kois JC. Influence of ceramic thickness and ceramic materials on fracture resistance of posterior partial coverage restorations. *Oper Dent.* 2015;40(2):211-217.

[34] Guess PC, Zavanelli RA, Silva NR, Bonfante EA, Coelho PG, Thompson VP. Monolithic CAD/CAM lithium disilicate versus veneered Y-TZP crowns: comparison of failure modes and reliability after fatigue. *Int J Prosthodont*. 2010;23(5):434-442.

[35]Richards D, Clarkson J. Evidence-based Dentistry: *Managing Information for Better Practice*. Quintessence Publishing; 2008:80-82.

[36] Bailey LF, Bennett RJ. DICOR surface treatments for enhanced bonding. *J Dent Res*. 1988;67(6):925-931.

[37] Pagniano RP, Seghi RR, Rosenstiel SF, Wang R, Katsube N. The effect of a layer of resin luting agent on the biaxial flexure strength of two all-ceramic systems. *J Prosthet Dent.* 2005;93(5):459-466.



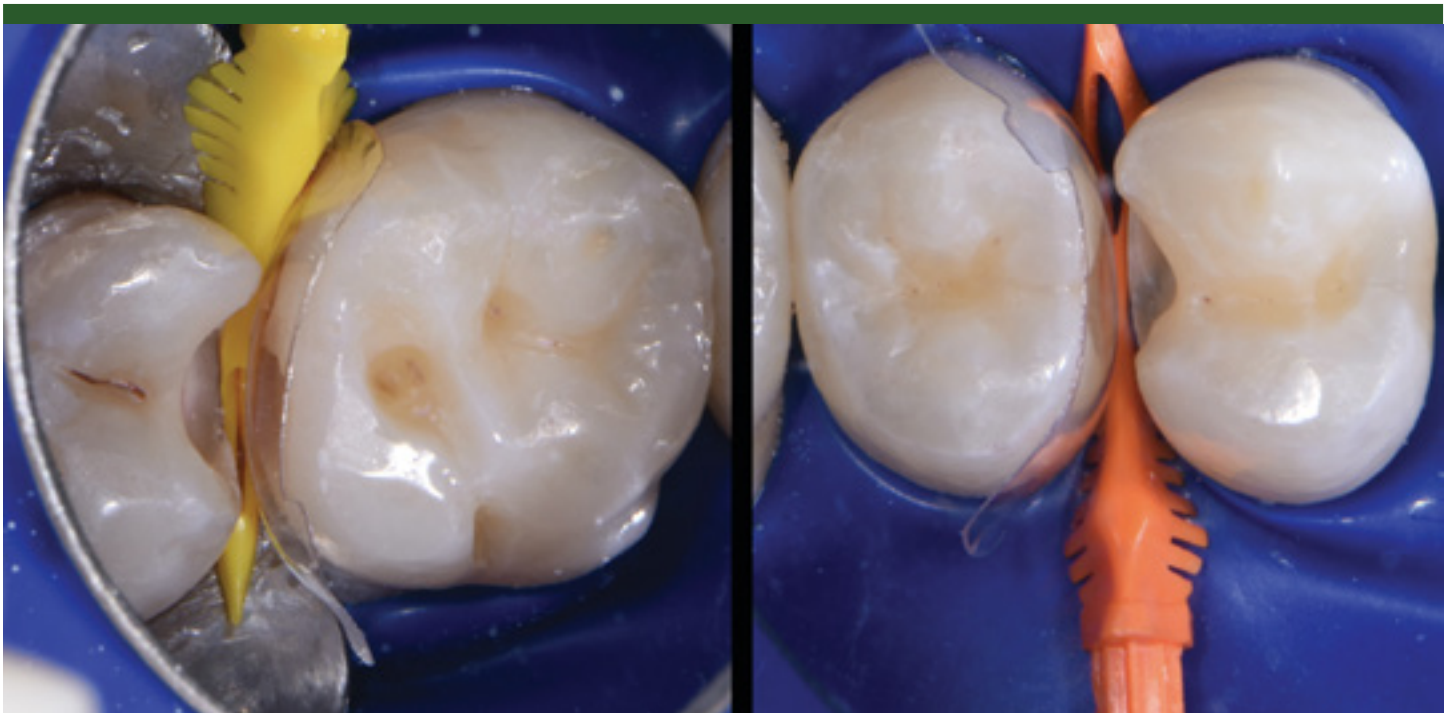
Kenneth A. Malament DDS, MScD, received his DDS from NYU College of Dentistry and a specialty certificate and master's degree from Boston University School of Graduate Dentistry. Dr. Malament has a full-time practice limited to prosthodontics in Boston that includes a dental laboratory with master dental technologists. A past-president of the American Board of Prosthodontics, he is a clinical professor at Tufts University and a course director in the postgraduate department of prosthodontics.

Mariam Margvelashvili-Malament, DMD, PhD, MSc is an assistant professor in the department of prosthodontics at Tufts University School of Dental Medicine. She is a diplomate of the American Board of Prosthodontics and fellow of American College of Prosthodontics. Dr. Margvelashvili-Malament received her DMD from the Tbilisi State University in Georgia in 2007, also master of science and doctoral degrees in dental materials from the University of Siena, Italy, in 2009 and 2013, respectively.

HOW TO INCREASE PREDICTABILITY AND DURABILITY OF POSTERIOR COMPOSITE RESTORATIONS: A CASE STUDY

Dr. Jihyon Kim presents a case study showing the restoration of a quadrant of posterior restorations using a different matrixing system and placement technique that is more ideally suited to work with composite resin properties.

BY JIHYON KIM, DDS



In order to consistently and predictably create high-quality posterior composite restorations, it is critical to reconsider the cavity preparation and placement techniques that are ideal for amalgam but do not work harmoniously with composite. The most common modes of failure for posterior composite restorations are fracture or chipping, especially at the marginal ridges, and secondary caries.[1] This article will address a different matrixing system and placement technique more ideally suited to work with composite resin properties.

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

IMPROVED METHODS AND PRODUCTS

Composite resin handles more like an injectable material that tends to incorporate porosities and defects with manipulation and layering. Such defects will leave the final composite restoration prone to chips and fractures. A variation of the snowplow technique—injection of flowable composite immediately followed by injection of regular composite—can create strong, monolithic restorations; better internal adaptation to cavity preparations; reduced void formation and microleakage; and resistance to fracture.

As the modern era of dentistry continues to evolve, product developments specifically geared to increase efficiencies and improve esthetics are coming to market in a steady stream. The first step for proper tooth separation and tight proximal contacts is pre-wedging. Pre-wedging offers many benefits including protection of hard and soft tissues from iatrogenic damage, tooth separation to accommodate matrix thickness, tighter contacts, and space for more conservative tooth preparation.

Two key components for tight contacts are wedges and separators; in the case of the Biofit Posterior Matrix System (Bioclear Matrix), the Diamond Wedge and the Twin Ring Separator are used. It is important to use a wedge with a low profile, which provides a gingival seal without distortion of the matrix. Additionally, the separator should be able to provide strong separation and help to seal the matrix along the gingival line angles.

The final piece of the puzzle is the composite materials. In this case, FiltekOne Bulk Fill Restorative (3M) and FiltekBulk Fill Flowable Restorative (3M) were used. Bulk filling is more time efficient, technically simpler, and creates a monolithic form. Manipulation of composites and layering is known for a higher incidence of voids and defects. This case demonstrates the method of injection molding, which has the ability to create strong, monolithic, void-free, ideally contoured, mirror-finish restorations. Significant time savings occurs with simpler finishing requirements. Excess composite at the mid buccal, lingual, and occlusal areas is quickly reshaped with a disc. The subgingival area is then finished with a finishing strip. Finally, it's time to finish and polish using a diamond-impregnated rubber polisher.

Just as Tofflemire bands, wooden wedges, and amalgam were suited for one another, anatomic matrices, wedges, separators, and flowable and bulk fill composites work harmoniously to create ideal posterior composite restorations that are strong, monolithic, and anatomic.

CASE STUDY

In the following case study (figures 1–11), the techniques and methods discussed will be demonstrated with the treatment of a quadrant of four posterior restorations. Four interproximal smooth-surface carious lesions are conservatively treated with two nonretentive saucer preparations and two marginal ridge-preserving opportunistic preparations.

Figure 1: Posterior quadrant occlusion marked with articulating paper prior to rubber dam isolation. Marking the occlusion helps with decisions about cavity access and preparations.

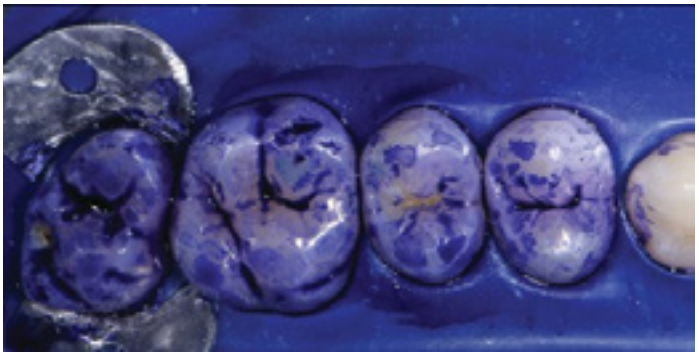


Figure 2: 2-Tone Disclosing Solution is applied to dried teeth to reveal biofilm.

Figure 3: Quadrant is pre-wedged with a small Diamond Wedge (pink) and two medium Diamond Wedges (orange). 2-Tone Disclosing Solution is rinsed to reveal biofilm.

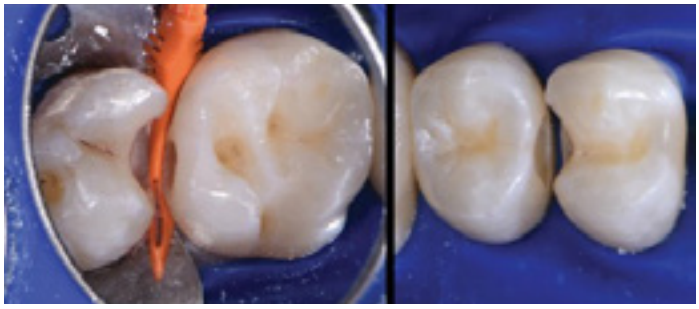


Figure 4: Quadrant is prepped, then biofilm and dentinal debris are removed with aluminum trihydroxide in Bioclear Blaster. No. 15 MOL prep, no. 14 DOL opportunistic prep, no. 13 MO opportunistic prep, and no. 12 DO prep.

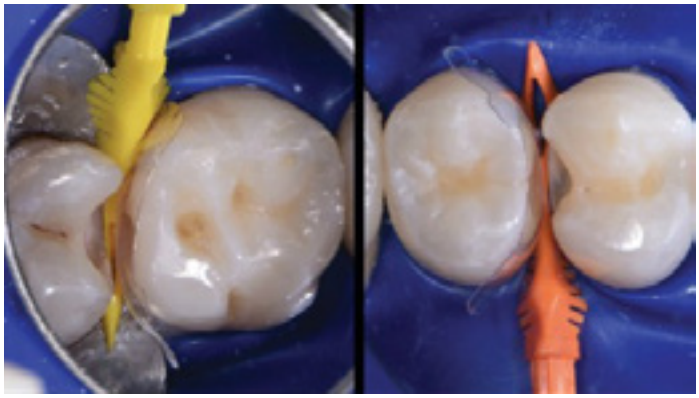


Figure 5: No. 14 distal is matrixed with Bioclear B302 matrix and stabilized with a large Diamond Wedge (yellow). No. 13 mesial is matrixed with Bioclear B302 matrix and stabilized with medium Diamond Wedge. (Orange).

Figure 6: No. 14 DOL and no. 13 MO are filled before removal of the matrix and wedge and before shaping. Restored with 3M Scotchbond Universal Adhesive, 3M Filtek Bulk Fill Flowable Restorative Universal Shade, and 3M Filtek One Bulk Fill Restorative Shade B1.

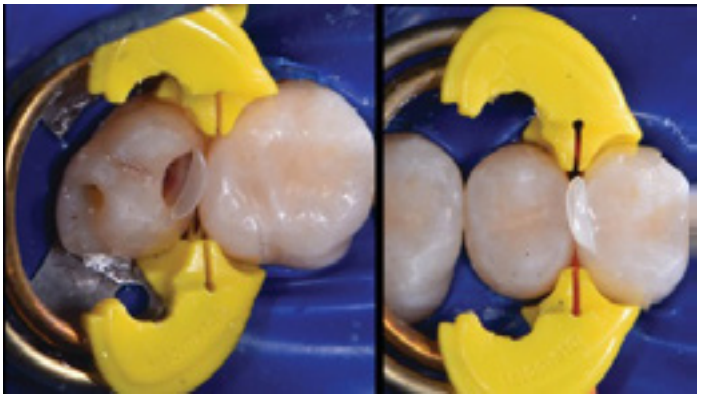


Figure 7: No. 15 MOL is matrixed with Biofit HD Molar 5.5 mm matrix, wedged with large Diamond Wedge (yellow), and separated with Bicuspid Twin Ring. No. 13 DO is matrixed with Biofit HD Bicuspid 5.5 mm matrix, wedged with medium Diamond Wedge (orange), and separated with Bicuspid Twin Ring.

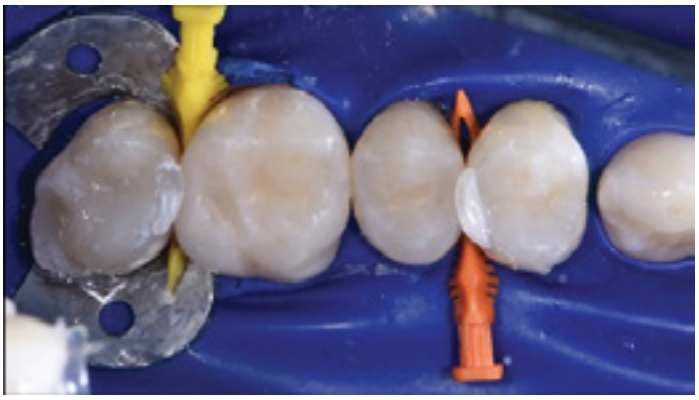


Figure 8: No. 15 MOL and no. 13 DO are filled and the Twin Rings removed. Both are restored with Scotchbond Universal Adhesive, Filtek Bulk Fill Flowable Universal Shade, and Filtek One Bulk Fill Shade B1.

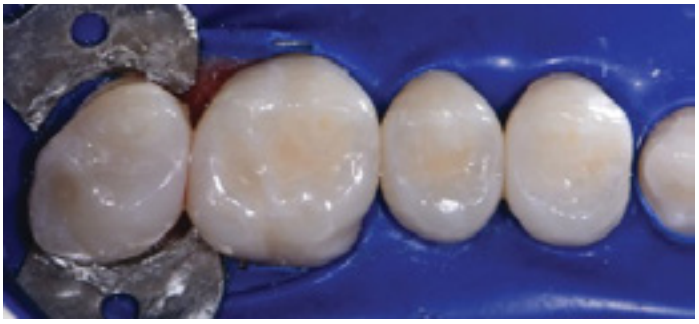


Figure 9: Occlusal view of the restored quadrant after disassembly. Shaping is quickly completed with 3M Sof-Lex XT Large Coarse Discs. Subgingival areas are finished with 3M Sof-Lex Finishing Strips. Polish is completed with Magic Mix prepolish (Bioclear) and diamond-impregnated rubber cup polisher.

Figure 10: Buccal view of the quadrant after disassembly and polish.

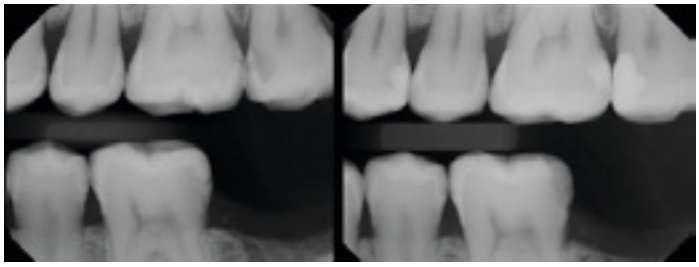


Figure 11: Pre- and postoperative radiographs of treated quadrant—teeth nos. 12–15. Note the very conservative nature of the preparations and the void-free monolithic fill with smooth subgingival contours, physiologic broad contacts, and rounded occlusal embrasures.

REFERENCE

[1] Alvanforoush N, Palamara J, Wong RH, Burrow MF. Comparison between published clinical success of direct resin composite restorations in vital posterior teeth in 1995–2005 and 2006–2016 periods. Aust Dent J. 2017;62(2):132-145. doi:10.1111/adj.12487

Jihyon Kim, DDS, is a graduate of the University of Washington School of Dentistry. With more than 20 years of experience, she practices with an emphasis on esthetic smile rejuvenation. Dr. Kim created the Smile Design Gauge, a multifunctional tool for predictable chairside smile design. She is director of the Institute of Injection Overmolding in Seattle, Washington. Contact her at drkim@jihyonkimdds.com or on Instagram @discingqueen.

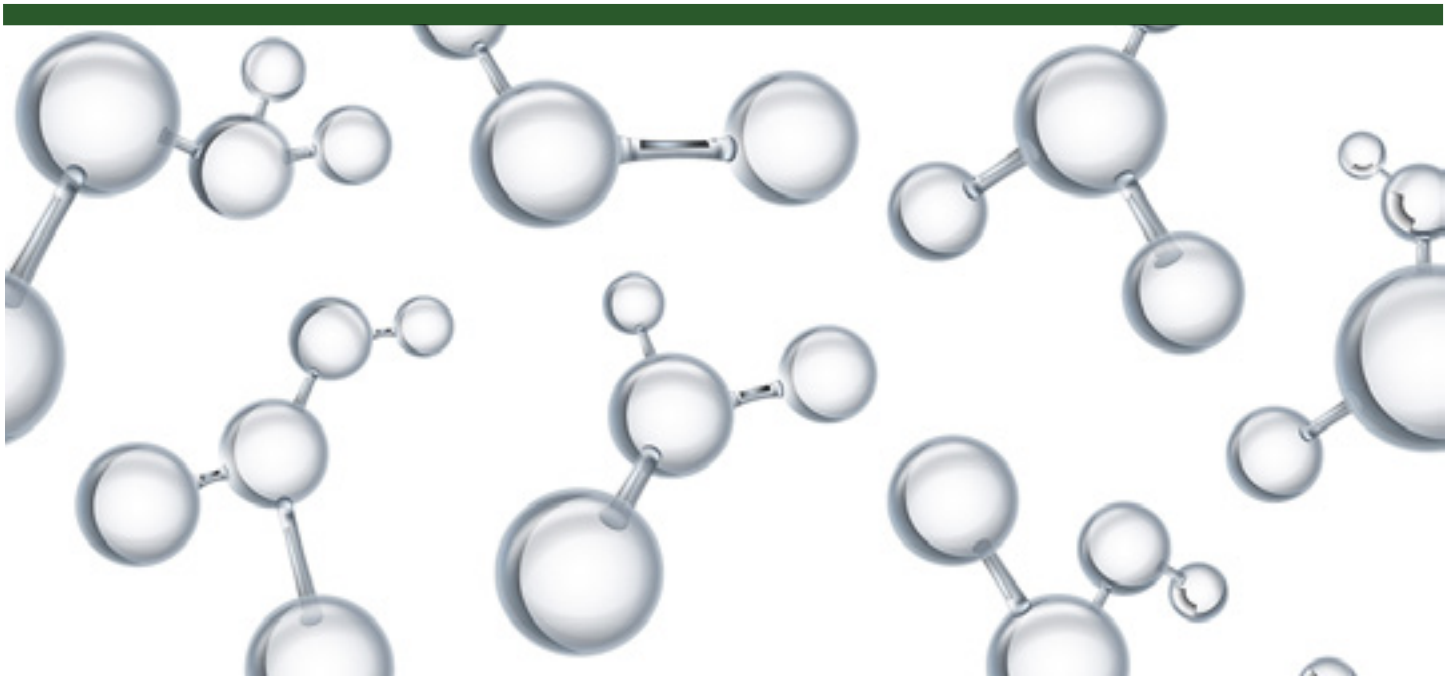
IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

COMBINING GLASS IONOMER, IDS, AND CEREC FOR INTELLIGENT HYBRID RESTORATIONS

Dr. Brian Nový says a combination of CEREC, composite bonding, and glass ionomer has produced undeniably successful results in some of his extreme-caries-risk patients.

BY BRIAN B. NOVÝ, DDS



We all know the feeling of a patient returning for a periodic exam only to find recurrent decay beneath a once-perfect restoration we proudly placed not long before. We often don't know what we'll find beneath another dentist's crown, and we worry it might look and feel like nougat. We're constantly managing the effects of CARS—caries associated with resin and sealants—hoping that our dentin bond will get better with the next restoration. However, composite resin's exceptional bond strength is offset by its lack of a chemistry-based defense against future acid attack. Marginal leakage

IN THE SPOTLIGHT: RESTORATIVE DENTISTRY

PAGES 3-12	ZEN AND THE ART OF VENEER...	PAGES 30-38	CHOOSING BETWEEN COMPLETE...
PAGES 13-23	COMPOSITE RESTORATIONS	PAGES 39-42	HOW TO INCREASE PREDICTABILITY
PAGES 24-29	CLINICAL CASE STUDIES	PAGES 43-45	COMBINING GLASS IONOMER...

studies and personal experience show that cariogenic acids sneak under composite bonds and undermine what seemed like a perfect restoration. For this reason, I've spent most of my career skeptical of composite resin.

In its place, I've used and advocated for glass ionomer, a calcium-fluoro-strontium glass with acid-neutralizing properties that make it much more effective in combating recurrent decay.

Recently, I documented my treatment of an extremely high-caries-risk patient suffering from medication-induced xerostomia.[1] The patient's treatment involved full-mouth restoration with large glass ionomer core buildups, supporting partial and full-coverage CeraSmart and CeraSmart 270 restorations. The technique I used with this patient was one I've developed over years of trial and error trying to bond my CEREC restorations to my favorite material, glass ionomer.

COMPOSITE RESIN AND GLASS IONOMER CAN COEXIST

During that trial and error, I found that composite resin chemistry and glass ionomer can coexist in a caries-preventive way. The combination of immediate dentin sealing (IDS), glass ionomer, and CeraSmart (force-absorbing hybrid ceramic) provides a comprehensive, predictable, caries-resistant, one-visit restoration that can be adapted to a variety of clinical scenarios.

I can understand why many dentists are still skeptical of glass ionomer based on the failure of early versions of ASPA in the 1970s. When I was in dental school, we shied away from the use of a material that wasn't as esthetic as composite, despite the fact it offered a true chemical bond to dentin and enamel and exhibited the same coefficient of thermal expansion as dentin. Glass ionomer was a material that couldn't compete with the myriad of layering and shade-matching techniques that composite offered the dental artists in my class. Even I would scratch my head and wonder why anyone would use an opaque material that dissolved away.

IMPROVEMENTS TO GLASS IONOMER CHEMISTRY

Thankfully, there have been significant improvements made to glass ionomer chemistry over the past three decades. Many dentists, however, don't keep it in their armamentarium because they're still unaware of these developments. In the last 10 years, the improvements in glass ionomer have made it one of the easiest and most effective methods of fighting caries in and around our restorations.

Glass ionomer, when applied to the tooth, fuses into a bioactive glass with a remarkable ability to sacrifice itself at the perfect moment. For a cavity to fully form, the tooth must reach a pH of 5.5 (the critical pH of hydroxyapatite), but glass ionomer chemically dissolves at a pH just above 5.5, releasing ions that neutralize the acid attack before it can irreparably damage the tooth. The presence of glass ionomer assures me that my restoration can withstand a lack of brushing and flossing without catastrophic failure. Sometimes I do see failures, but rarely am I chasing recurrent decay as deeply as I once did. Glass ionomer makes the damage fixable, as the restoration is often easily repaired with bonding or glass ionomer.

Of course, glass ionomer isn't perfect. Early on, the main problem I'd encounter with this material was its inability to bind effectively to

my preferred CEREC block, the hybrid ceramic resin that is CeraSmart. While I could achieve some temporary bonds and I was happy to see less recurrent decay, I needed to find a better way to retain my onlays and crowns.

A COMBINATION TECHNIQUE

Thankfully, developments in glass ionomer's chemistry have coincided with significant improvements in bonding techniques. A short while ago, I was introduced to the IDS technique, the efficacy of which made me rethink my skepticism of composites. IDS was the missing link for a restoration design that needed structural durability along with a chemistry-based defense. With it, I realized that I could get the best of all three materials—combining the anticaries properties of the glass ionomer, the superior bonding capabilities of IDS, and the strength of a ceramic resin hybrid.

The result is what I consider an amalgamation of the co-cure technique, the sandwich technique, and modern composite bonding. The benefits of combining these techniques are multifold. CEREC technology allows the creation of an indirect restoration right in the office in about 10 minutes; CeraSmart doesn't need to be fired and polishes chairside in minutes. My patients can watch the CEREC machine fabricate their computer-designed tooth, and I'm confident that the glass ionomer is protecting the tooth under my restoration and will slow future cariogenic attacks.

I've always been a "cariologist" at heart. I used to say, "If I can't fix a tooth with glass ionomer, I'll fix it with resin-modified glass ionomer. And if I can't fix it with resin-modified glass ionomer, I'll lay hands on you and pray." I haven't said that in quite a while with my newfound appreciation for what my composite-loving colleagues have been touting for some time. I never thought I'd use CEREC, and I never thought I'd write about my use of composite bonding. But combining those technologies with glass ionomer has produced undeniably successful results in some extreme-caries-risk patients. I've found peace of mind is in my patient's caries-resistant and CEREC-restored piece of mouth.

REFERENCE

[1]Novy BB, Kennedy EN, Donahoe J, Fournier S. Minimizing aerosols with non-surgical approaches to caries management. *J Mich Dent Assoc.* 2020;102(7):48-56.

Brian B. Nový, DDS, is the chief dental officer of the Alliance Dental Center, Massachusetts Public Employees Fund. He served as president of the National CAMBRA Coalition and is currently the consumer representative to the United States Food & Drug Administration Dental Products Panel. His awards include the American Dental Association (ADA) Adult Preventive Care Practice of the Year, the Academy of General Dentistry Weclew Award, the Dugoni Award, and the ADA Evidence-Based Dentistry Practice Award.