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Researchers: Chlorhexidine improves bond strength

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Want to make your restorations last longer? Add a dab of chlorhexidine to the preparation. That's the latest tip from some researchers presenting their findings at the recent American Association for Dental Research (AADR) meeting in Washington, DC. In fact, a few dental professors are so convinced it works they're already teaching it to their students as standard procedure.

And surprisingly, the main argument for adding this well-known disinfectant has nothing to do with bacteria.

"I think we're one of the first schools in the country to use it," said Peter Moon, Ph.D., director of the Virginia Commonwealth University Dental Biomaterials Laboratory. "I feel pretty strongly that it works."

Moon expects his review of the research to be published in a forthcoming issue of the *Open Dentistry Journal*. Another research group published a clinical trial last summer in *Operative Dentistry* (July-August 2009, Vol. 34:4, pp. 379-383). And two presentations on the topic at the AADR meeting generated some of the gathering's hottest buzz.

Why it might work

The notion of disinfecting preparations has come in and out of vogue in dentistry for years. And many experts still think chlorhexidine might serve that purpose. But the new reason for using it comes from an entirely different chemical process.

To the list of problems that make a filling fail, they say, it's important to include the tooth's attack on itself.

For decades now, researchers have been studying matrix metalloproteinases (MMPs). Secreted by bone and tooth cells, MMPs serve useful purposes. For example, they help remodel bones in response to physical stress. But they can also become loose cannons, wrecking healthy tissue.

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In a tooth, they help mineralize dentin, and once the dentin is formed they remain bound in an inactive form within it. Caries changes all that. Lactic acids secreted by caries bacteria can reactivate MMPs and cause them to attack the collagen matrices around them, even within the hybrid layer of a restoration. In this way, they can weaken the bond of a restoration. Acids present in self-etch adhesives may have the same effects.

Phosphoric acid -- which is used in etch-and-rinse adhesive systems -- appears to deactivate MMPs, Moon said. But even with these systems, the hydrophilic organic acids in resin primers have been shown to reactivate the MMPs. More MMPs may find their way into the hybrid layer through dentin tubules or seep in through the microleakage of saliva and crevicular fluid.

Some of the leading dental researchers think the attack of these enzymes on collagen may help explain why composite resin bonds weaken with time. And they've begun testing the notion that chlorhexidine could block the MMPs from doing this damage.

The evidence

But you can't just put chlorhexidine on any composite restoration and expect a good result. The chlorhexidine itself may influence the extent of polymerization. For this reason, researchers are doing lots of short-term laboratory studies to see which types of resin they can safely combine with the disinfectant. One such study, presented at the AADR meeting by Tufts University researchers, looked at Filtek Supreme Plus (3M ESPE) restorations bonded to dentin with PeakLC (Ultradent) adhesive. They found no effect of the chlorhexidine on bond strength after a month.

But to know whether chlorhexidine actually preserves dentin, you have to try it out in living human beings. A team of researchers from Brazil, the U.S., Finland, and Italy did just that for a study published in June 2007 (*Journal of Dental Research*, Vol. 86:6, pp. 529-533).

They put fillings in pairs of noncarious third molars that were scheduled for extraction from 12 people. They created cavities in the molars on both sides of each patient's mouth. On one side of each mouth, they restored these cavities by etching with phosphoric acid, then applying Single Bond (3M ESPE), followed by Clearfil Protect Liner (Kuraray Medical) and Filtek Z250 (3M ESPE).

On the other side of each mouth, they followed the same procedure except that they pretreated the acid-etch dentin with 2% chlorhexidine digluconate. After 60 seconds, they blotted the chlorhexidine before applying the adhesive.

Then they immediately extracted the pairs of molars from three of the patients, leaving the other nine pairs in the patients' mouths for 14 more months before finally extracting them.

Cutting the teeth into three sections, the international team scrutinized two sections of each tooth with transmission electron microscopy. The other section they cut into beams to measure microtensile strength.

As expected, the immediately extracted teeth had the same bond strength whether or not they were treated with chlorhexidine. But significantly, in the teeth extracted after 14 months, the bond strength dropped by a third, from 29.3 (± 9.2) megapascals (MPa) to 19.0 (± 5.2) MPa ($p < 0.05$).

And in looking at their specimens with high-powered microscopes, the researchers saw little difference between the hybrid layers of the immediately extracted restorations and those in the 14-month-old restorations treated with chlorhexidine. On the other hand, they saw degradation of the hybrid layer in the restorations not preserved by chlorhexidine -- in some places, collagen fibrils had completely disintegrated.

How to use it

The results didn't prove that MMPs caused the problem, but it's hard to know what else might have done it. The researchers saw no sign of bacteria in the restorations. And regardless, the study findings did suggest a powerful protective effect for chlorhexidine. Nor was this the first study to show this effect. A very similar one, involving some of the same researchers, was published in the *Journal of Dental Research* in August 2005 (Vol. 84:8, p. 741-746).

Impressive as these results may be, they haven't closed the case. Longer-term studies would help. "We're keeping an eye on the evidence on collagen stabilization and may start teaching if it becomes evident it improves longevity of the bond," wrote James B. Summitt, D.D.S., M.S., chair of restorative dentistry at the University of Texas at San Antonio, in an e-mail to *DrBicuspid.com*.

And because of the interaction between chlorhexidine and some composite resins, "it's not a universal thing you can just use," Moon warned. He and other researchers are experimenting with different protocols and various concentrations of chlorhexidine.

For now, here's what the Virginia Commonwealth professors teach:

1. Etch with 37% phosphoric acid for 15 seconds.
2. Rinse thoroughly with water, and dry to a moist surface.
3. Apply 2% chlorhexidine digluconate solution (Ultradent) for 60 seconds. (The data don't show yet whether 0.12% chlorhexidine rinse will work for this purpose.)
4. Apply an adhesive resin in at least two coats without pooling. Virginia Commonwealth uses OptiBond Solo Plus (Kerr Dental).
5. Dry with air pressure for 10 seconds after each coat to evaporate the solvent.

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