Glass Fiber Reinforcement Provides Dental Material Strength And Flexibility

University of Connecticut



Two researchers at the University of Connecticut Health Center create a new dental composite named FibreKor® with the strength characteristics of a stealth bomber's surface, and aesthetic characteristics that please dentists and patients.

What might stealth bombers and some modern dental bridges, crowns, splints and posts have in common? At first glance, not much. But if you look below the surface of FibreKor®, a dental composite, and the skin of the bomber, you'll find tiny glass reinforcing fibers that make both durable and strong.

Two University of Connecticut Health Center researchers — materials scientist Jon Goldberg, Ph.D., and orthodontist Charles Burstone, D.D.S. — collaborated in the late 1980s to create the fiber-reinforced material now used by dentists around the world in a number of dental devices.

The Old State of the Art Was Metal

“Before we did this, the state of the art was metal,” Burstone says. “But metal is not transparent and, unfortunately, has the undesirable effect of darkening the tooth.”

Once technicians build the base of a FibreKor® bridge or crown, they coat it with an existing plastic restorative material to complete the artificial tooth that is strong and natural looking — without requiring a metal base. Posts and splints also are advantageous because they look like real tooth enamel. And dentists can use FibreKor® to make some dental devices right in their offices on a while-you-wait basis.

This high-quality and flexible product is the first commercially successful dental application of a fiber-reinforced composite, and it’s an ideal fit in the field. “People had tried to use polymers in the past. But they didn’t have the rigidity or other attributes needed for dentistry,” Burstone says. “But by putting in fibers, we discovered that you could have both pleasing aesthetics and the desired mechanical properties.”

Going Outside the Literature

To find answers for their endeavor, the pair went outside dental literature — to the U.S. Air Force. “We looked at how they made the skin of stealth bombers,” he says. “And we found some of the information there.

“I don’t know if this is the gold standard for dentistry,” Burstone says. “But the polymer products look much better than metal, certainly.”

Goldberg says he and Burstone have been working together for nearly three decades. “We go way back,” chuckles Goldberg, who chose to specialize in dental materials when he was a graduate student at the University of Michigan. He received his Ph.D. in materials science from the University of Michigan Schools of Dentistry and Engineering.

“I had a number of opportunities, but I liked the challenges that dentistry posed,” he says. “I also liked the people in the dental school.” He began his collaboration with Burstone when he joined the University of Connecticut Health Center faculty.

A Long Way From Stainless Steel

In one of their first projects, they developed a titanium alloy that was used to replace stainless steel wires traditionally used in orthodontics. “The great thing about it was that it had a lot more flexibility,” he says.

Then, they turned their attention to what became FibreKor®. “We looked over materials available and settled on fiber reinforced composites,” he says. “What we initially developed, though, was not used for the orthodontic application that we’d originally intended. We had hoped to use fiber-reinforced composites for orthodontic wires as a follow-up to the titanium wires.”

But they didn’t give up because they were convinced that what was eventually marketed as FibreKor® would be useful in dentistry. So they set about refining their discovery.

“In a sense, it was a kind of serendipity,” he says. “Once we had it in hand, we saw that it could be used for various dental applications like bridges and posts.”

> *The idea of using fiber-reinforced composites had never been successfully applied to dentistry. “It was a puzzle that had yet to be figured out,” Goldberg says.*

“But the defense industry had made strides, so we researched what the military had done. Then we were able to properly identify a dental need and, then, adapt FibreKor® to retain the characteristics we wanted,” Goldberg says. Burstone and Goldberg received their first of two U.S. patents in 1988.

Initially, Dentists Were a Tough Crowd

Even after they came up with their prototype, the materials didn’t immediately gain acceptance in the dental world. “To be honest, it was like a number of things we have done,” Goldberg says. “At first, we could not get people to adopt it … It takes a combination of having a fairly well developed prototype and a commercial partner with interest in that area. It took off when that partner was identified,” he says.

That partner was Pentron, a small company in Wallingford, Conn., and one of the world’s prominent makers of dental materials. Pentron signed the first of two exclusive licenses with the University of Connecticut in 1996, and introduced the first fiber-reinforced composite materials to the dental market in early 1997.

Pentron Helps Get Dentists’ Attention

Joe MacDougald, chief operating officer of the privately held Pentron, was involved with negotiating the original licenses with the university. He calls FibreKor® a “great technology” and says his company liked the material because it replaced less attractive metal materials.

“FibreKor® posts have much of the strength of metal,” he says. “Moreover, it bonds better than metal and it’s easier for dentists to use. They can apply the Splint-It® version of the material chair-side in strips to stabilize or repair teeth in the office. And it replaces the metal understructure of the crown and gives just as strong support,” he says. “With a composite up above, the substructure and the tooth can match each other.”

Pentron first introduced FibreKor® to replace metals for crowns and bridges. Its second product, Splint-It®, became available in fall 1997 to hold groups of teeth together to compensate for a lack of gum or bone support. Dentists also use it to splint teeth together to simplify and make more aesthetic orthodontic treatment and retention. Pentron’s third product, the FibreKor® post, was unveiled in 1998 as an alternative to traditional metal posts that support the construction of a crown after root canal procedures.

Root Canal Posts Are the Biggest Application

Golberg says FibreKor®’s biggest application is in dental posts. He estimates that fiber-reinforced composites comprise 20 to 30 percent of root canal posts. “If you have a root canal, but not enough tooth left to properly restore, a post will

provide the additional retention necessary for a crown," he says.

FibreKor® is gaining in popularity for several reasons, Goldberg says. "Aesthetics is one big issue," he says. "Metal post creates a shadow in the tooth because it is darker. But polymers also bond better than metal … And anything you do with teeth, you want to have a good bond."

Finally, the processing is easier. "You don't have to do metal casting and you don't have high-temperature metal handling," he says. "It's a winner."

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