Scientists invent dental fillings that kill bacteria and remineralize the tooth

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(Medical Xpress) -- Scientists using nanotechology at the University of Maryland School of Dentistry have created the first cavity-filling composite that kills harmful bacteria and regenerates tooth structure lost to bacterial decay.

Rather than just limiting decay with conventional fillings, the new composite is a revolutionary dental weapon to control harmful bacteria, which co-exist in the natural colony of microorganisms in the mouth, says professor Huakun (Hockin) Xu, PhD, MS.

"Tooth decay means that the mineral content in the tooth has been dissolved by the organic acids secreted by bacteria residing in biofilms or plaques on the tooth surface. These organisms convert carbohydrates to acids that decrease the minerals in the tooth structure," says Xu, director of the Division of Biomaterials and Tissue Engineering in the School's Department of Endodontics, Prosthodontics and Operative Dentistry.

After a dentist drills out a decayed tooth, the cavity still contains residual bacteria. Xu says it is not possible for a dentist to remove all the damaged tissue, so it's important to neutralize the harmful effects of the bacteria, which is just what the new nanocomposites are able to do.

The researchers also have built antibacterial agents into primer used first by dentists to prepare a drilled-out cavity and into adhesives that dentists spread into the cavity to make a filling stick tight to the tissue of the tooth. "The reason we want to get the antibacterial agents also into primers and adhesives is that these are the first things that cover the internal surfaces of the tooth cavity and flow into tiny dental tubules inside the tooth," says Xu. The main reason for failures in tooth restorations, says Xu, is secondary caries or decay at the restoration margins. Applying the new primer and adhesive will kill the residual bacteria, he says.

Fillings made from the School of Dentistry's new nanocomposite, with antibacterial primer and antibacterial adhesive, should last longer than the typical five to 10 years, though the scientists have not thoroughly tested longevity. Xu says a key component of the new nanocomposite and nano-structured adhesive is calcium phosphate nanoparticles that regenerate tooth minerals. The antibacterial component has a base of quaternary ammonium and silver nanoparticles along with a high pH. The alkaline pH limits acid production by tooth bacteria.

"The bottom line is we are continuing to improve these materials and making them stronger in their antibacterial and remineralizing capacities as well as increasing their longevity," Xu says.

The new products have been laboratory tested using biofilms from saliva of volunteers. The Xu team is planning to next test its products in animal teeth and in human volunteers in collaboration with the Federal University of Ceara in Brazil.

Provided by University of Maryland