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Stem Cell Technique Could Help Kids Avoid Root Canal

By Alan Mozes

The promise of stem cells may someday help kids say goodbye to the dreaded root canal, scientists report.

A new, less-invasive treatment leaves the soft inner pulp intact, allowing the young tooth's stem cells to continue tooth formation.

"Removing infected tissue by root canal is invasive, and, by doing that, we stop the tooth's continuous maturation process and leave behind a child with a thin eggshell of a tooth that is weak and susceptible to fracture," explained researcher Dr. George T.-J. Huang, an endodontist (root canal specialist) and an associate professor with the University of Maryland's College of Dental Surgery.

In the December 2006 issue of the *Journal of Endodontics*, his team reviewed four cases of preteen tooth decay treated by Taiwanese dentists who cleaned infected tooth tissue but did *not* remove it -- leaving pulp stem cells to remain in place. These stem cells went on to help the teeth recover, regenerate, and mature into strong healthy teeth.

The researchers stressed that the stem cells in question are adult stem cells (rather than controversial embryonic stem cells) that all children and adults possess. And the cleaning procedure that they used to replace traditional root canal is based on the application of a bleaching substance, rather than any introduction of externally derived stem cells.

"By leaving the tissue and just removing the infection, we observed in these cases that not only are the gums healed and the children's teeth free from infection and abscesses but, most importantly, there is a stem-cell aided completion of the root formation and tooth maturation over time," Huang said.

His team focused on a common form of tooth decay called periodontitis. The condition stems from deposits of bacterial plaque below the gum line that can lead to tissue and bone decay, gum recession, exposure of tooth roots, and eventually tooth loss.

Endodontists typically offer patients root canal to treat this condition. Root canal involves the use of dental instruments to remove the infected soft pulp tissue -- commonly referred to as "nerve" tissue -- located in the center of the tooth. The hollowed-out pulp chamber that once housed the extracted tissue is then filled and sealed to prevent re-infection or the spread of bacteria to other areas.

According to dental experts, the excised nerve tissue is not critical to normal oral function once adult teeth have matured, so removal of degenerated matter does not induce long-term problems.

However, nerve/pulp tissue is vital to the healthy development of teeth in children under the age of 16. The adult tooth-maturation process takes approximately three years to complete from the time a tooth first appears.

That means that in younger patients, root canal can stop this process and boost risks for dental complications, fractures, and even facial disfigurement.

But Huang's team knew that the pulp in maturing teeth is much richer in blood supply than that seen in adults. It also has a greater ability to regenerate itself compared to the pulp inside adult teeth. That's because stem cells inside children's teeth have the capacity to generate into the material that forms "dentin" -- the tooth's primary connective tissue.

So, would periodontitis treatments that allowed stem cells to stay in place and do their vital work leave kids with stronger teeth?

To find out, Huang's team tackled four cases of periodontitis in Taiwanese boys and girls between the ages of nine and 10 who were treated for the disease between 1988 and 2000.

In place of a root canal, the pulp chambers of the children's problem teeth were irrigated with about 20 ml of 2.5 percent sodium hypochlorite -- a chemical compound often used as a disinfectant and bleaching agent.

Following the cleansing, the teeth were dried and filled with a calcium hydroxide paste -- a removable anti-microbial compound. The researchers avoided the use of invasive filling, so that they could preserve the affected tissue and avoid unnecessary extraction of helpful stem cells.

The process was repeated several times until radiographic exams revealed full tooth healing and an absence of periodontitis symptoms.

Follow-up exams carried out for up to 5 years after the treatment showed that in all cases, the disease was halted and affected teeth grew to healthy maturity.

No complications ensued, and the only observed side effect was a narrowing -- in some instances severe -- of the root canal space.

Huang and his colleagues concluded that their findings "strongly suggest a paradigm shift" in treatment of immature adult teeth, with an emphasis placed on encouraging a natural regenerative tissue process rather than getting in the way by using artificial filler materials.

In the future, these types of techniques might even help in the treatment of adults' teeth.

"Of course, more research is needed to further improve the treatment by making it more predictable and laying down more detailed criteria for selecting those cases that have the highest chance to become successful," said Huang. "But clearly, this brings out greater awareness of the possible importance of stem cells for extensive clinical applications in the future."

Dr. Jim Crall, chairman of pediatric dentistry at the University of California, Los Angeles, was cautiously enthusiastic about the new approach.

"It's clearly quite premature to suggest that you abandon root canals in these cases," Crall said. "And, obviously, more studies are needed to determine the parameters or contraindications of this procedure and to ensure a process for following the patient long-term. But, certainly, this is exciting and suggests great potential."

In a related study, a multi-national research team successfully regenerated tooth root and supporting periodontal ligaments to restore tooth function in an animal model. The breakthrough holds promise for clinical application in human patients, said the researchers, headed by Dr. Songtao Shi at the University of Southern California School of Dentistry.

Using stem cells taken from extracted wisdom teeth of 18- to 20-year-olds, the researchers created enough root and ligament structure to support a crown restoration in their animal model. The resulting tooth restoration closely resembled the original tooth in function and strength.

Shi said the hope is the research could one day benefit dental patients who are not appropriate candidates for dental implant therapy or would prefer living tissue derived from their own teeth.

The findings are published in the Dec. 20 inaugural issue of *PLoS ONE*.

More information
For additional information on periodontal disease, visit the American Academy of Periodontology.