MedicalXpress

Dental surgeon engineers tissue replacement

October 15 2010, by Beth Kwon

(PhysOrg.com) -- Earlier this year in a report in *The Lancet*, Columbia professor Jeremy Mao and his team showed that a joint could be grown with a host's own stem cells, presenting a potential alternative for the 400,000 people who receive an artificial knee or hip each year. He has also demonstrated that it is possible to regenerate a new tooth from stem cells, which offers hope that one day dentures and implants may become a thing of the past.

As a child growing up in China, Jeremy Mao was fascinated by mechanical clocks, taking them apart and putting them back together. "When you ended up with extra parts, you would know you screwed up," he recalls with a laugh.

That dexterity, along with the influence of his geneticist father, inspired him to pursue oral surgery. "In dentistry you operate all the time, so I figured it would be a good fit," says Mao, whose 1983 D.D.S. from Wuhan University in China was followed by an oral surgery residency and practice.

Since then, Mao's curiosity has led him into the esoteric fields of tissue engineering, research with adult stem cells and regenerative medicine with stints at a number of prestigious institutions in the United States and Canada, culminating in his 2006 appointment at Columbia.

Earlier this year in a report in *The* Lancet, Mao and his team at Columbia showed that a joint could be grown with a host's own stem

cells, presenting a potential alternative for the 400,000 people who receive an artificial knee or hip each year. He has also demonstrated that it is possible to regenerate a new tooth from stem cells, which offers hope that one day dentures and implants may become a thing of the past.

Mao sees a connection between his early medical training and his recent work at the College of Dental Medicine. He says the common thread is "wound healing."

"I look at clinical needs. If you live long enough you'll have arthritis," says Mao, who is the Edward V. Zegarelli Professor of Dental Medicine at the medical center. "There's also a large segment of our society who have missing or extracted teeth."

Mao's most recent breakthrough came in August, when he published a study in the Journal of Clinical Investigation showing that a particular molecule can be used to regulate stem cells, instructing them to become fiber-forming cells, rather than bone-forming or cartilage-forming cells.

It suggests a potential new treatment for infants with craniosynostosis, a defect that occurs in one in 2,500 live births in which the cranial sutures, which connect the bone plates of the skull, fuse too soon. The disorder can lead to constricted brain growth and a misshapen skull, as well as neurological disorders such as blindness, seizures or mental retardation.

Current treatment involves a traumatic and lengthy procedure in which surgeons remove the fused joints and reshape parts of the skull, piecing it back together with the help of metal plates and screws. Infants wear a helmet during the recovery period, and sometimes additional procedures are required if the joints fuse again.

Mao's alternative is simpler. "It's a Jell-O-like material that the surgeon could simply inject, and the procedure is local so you would just remove

the one fused piece of bone rather than cut many of the bones in the skull," says Mao.

With the new treatment, operating costs would be reduced to a fraction of what they are now; Mao also notes that the current treatment relies heavily on a surgeon's skill, which can vary greatly.

Mao's stem cell research has broad applications, from craniosynostosis to arthritis and tooth loss. Several years ago, his research team made headlines after creating a breast implant from stem cells. He has also used stem cells to grow bone and cartilage for an engineered temporomandibular joint (TMJ). About 10 million people in the United States suffer from TMJ problems, and in the most severe cases, must rely on a liquid diet. Work in these areas is continuing in Mao's laboratory at Columbia.

"To me, there's very little distinction between dentistry and medicine when one embarks on a research project," he says. "Whether that patient has a missing tooth or arthritic joint, you've got to take care of the patient, and preferably with regenerative technologies."

Provided by Columbia University