Technique yields potential biological substitute for dental implants

May 24 2010

A technique pioneered in the Tissue Engineering and Regenerative Medicine Laboratory of Dr. Jeremy Mao, the Edward V. Zegarelli Professor of Dental Medicine at Columbia University Medical Center, can orchestrate stem cells to migrate to a three-dimensional scaffold infused with growth factor, holding the translational potential to yield an anatomically correct tooth in as soon as nine weeks once implanted.

People who have lost some or all of their adult teeth typically look to dentures, or, more recently, dental implants to improve a toothless appearance that can have a host of unsettling psycho-social ramifications. Despite being the preferred (but generally painful and potentially protracted) treatment for missing teeth nowadays, dental implants can fail and are unable to "remodel" with surrounding jaw bone that undergoes necessary changes throughout a person's life.

An animal-model study has shown that by homing stem cells to a scaffold made of natural materials and integrated in surrounding tissue, there is no need to use harvested stem cell lines, or create an environment outside of the body (e.g., a Petri dish) where the tooth is grown and then implanted once it has matured. The tooth instead can be grown "orthotopically," or in the socket where the tooth will integrate with surrounding tissue in ways that are impossible with hard metals or other materials.

"These findings represent the first report of regeneration of anatomically shaped tooth-like structures in vivo, and by cell homing without cell

delivery," Dr. Mao and his colleagues say in the paper. "The potency of cell homing is substantiated not only by cell recruitment into scaffold microchannels, but also by the regeneration of periodontal ligaments and newly formed alveolar bone."

This study is published in the most recent *Journal of Dental Research*, the top-rated, peer-reviewed scientific journal dedicated to the dissemination of new knowledge and information on all sciences relevant to dentistry, the oral cavity and associated structures in health and disease.

Dental implants usually consist of a cone-shaped titanium screw with a roughened or smooth surface and are placed in the jaw bone. While implant surgery may be performed as an outpatient procedure, healing times vary widely and successful implantation is a result of multiple visits to different clinicians, including general dentists, oral surgeons, prosthodontists and periodontists. Implant patients must allow two to six months for healing and if the implant is installed too soon, it is possible that the implant may fail. The subsequent time to heal, graft and eventually put into place a new implant may take up to 18 months.

The work of Dr. Mao and his laboratory, however, holds manifold promise: a more natural process, faster recovery times and a harnessing of the body's own potential to re-grow tissue that will not give out and could ultimately last the patient's lifetime.

"A key consideration in tooth regeneration is finding a cost-effective approach that can translate into therapies for patients who cannot afford or who aren't good candidates for dental implants," Dr. Mao says. "Cell-homing-based tooth regeneration may provide a tangible pathway toward clinical translation."

Dr. Ira B. Lamster, dean of the College of Dental Medicine, stated: "This

research provides an example of what is achievable when today's biology is applied to common clinical problems. Dr. Mao's research is a look into the future of dental medicine."

Provided by Columbia University Medical Center