Stem cells are the body's cardinal cells. They are responsible for our natural ability to repair common injury. They have intrinsic capabilities of both replicating themselves as well as differentiating into other types of cells. Despite not being identical, stem cells have widely differing abilities. Modern Biology has helped/been helping us to better comprehend the mammalian development process starting from a single cell with totipotent nature to a completely developed adult organism. Embryonic stem cells (ESCs) derived from the epiblast have been in use widely in stem cell based therapies. Recently, induced pluripotent stem cell (iPSC) production from almost any mature cell type in our bodies, is benefitting stem cell based therapies as the ethical concerns about using ESCs began to surface. These breakthrough studies have facilitated the differentiation of various pluripotent stem cell (PSC) populations into somatic cell derivatives in vitro. Adult stem cells derived from various tissues owing to their intrinsic abilities to self-renew and differentiate into the cell types while retaining genomic stability have garnered much attention. Mesenchymal stem cells (MSCs), a well-characterized population of adult stem cells is found in the teeth as well as in the bone marrow. They can form a variety of cell types in the laboratory, including fat cells, cartilage, bone, tendon and ligaments, muscle cells, skin cells and even nerve cells. MSCs from teeth, like their counterparts from other sources can be obtained and expanded to quantities appropriate for medical use. This ability makes them an ideal candidate for use in procedures involving tissue repair. They have been successfully used to repair tissue in both humans and animals without problems. They can regenerate and repair bone, cartilage, muscle, skin, heart, and nerve tissue. Advances in three-dimensional (3D) culture systems have capacitated partial recapitulation of the complexity of mammalian organogenesis in vitro. It also made possible generation of transplantable tissues. Thanks largely to the efforts of researchers, culturing stem cells derived from various sources (hESCs/hiPSCs/hAdSCs) in 3D has opened up hitherto unknown possibilities for the exploration of human development and the development of regenerative medicine approaches.

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FROM THE LABORATORY......
Bio-tooth: Fab or Fad?

Dental implants will soon be history. Bio-tooth is the buzzword as a replacement for a lost tooth, thanks to comprehensive research going on around the world. Dr. Jeremy Mao, professor of Dental Medicine at Columbia University is leading the research in developing a cost-effective clinical therapy technique to create a bio-tooth. The growth factor incorporated 3D scaffolding acts as a reservoir and attracts stem cells, colonizing the homing device. The tooth can grow in the scaffolding, when placed in the socket and merge with the surrounding tissues in nine weeks.

Scientists working in the tissue engineering and regenerative medicine laboratory at the Columbia University have developed a patented technique and have attained considerable success both in vitro (petri dish) and in vivo (mice). The research led by Dr. Paul Sharpe, Professor and expert in craniofacial development and stem cell biology at king’s college, London published a report in the Journal of Dental Research. They focused on the generation of immature tooth bud (primordial embryonic tooth) that can be transplanted in adult jaws as small cell pellets to develop into a functional tooth. They have succeeded in transplanting a combination of epithelial and mesenchymal cells in mice to generate a hybrid tooth containing enamel and dentine with viable roots. This bio-tooth formation can become an alternative to titanium dental implants in future. Bio-tooth development in the lab is reliant on autologous MSCs. Dental pulp-derived stem cells (DPSCs) are hot candidates for patient derived stem cell based Bio-tooth development. This calls for the need to bank stem cells from human exfoliated deciduous teeth (SHED). Preserving your child’s deciduous tooth, to be saved as an excellent source of MSCs for development. This calls for the need to bank stem cells from human exfoliated deciduous teeth (SHED). Preserving your child’s deciduous tooth, to be saved as an excellent source of MSCs for developing bio-tooth in the future is the most valuable gift you can give your precious ones. I have been advising my patients these days. Let us not give the kid’s milk tooth to the tooth fairy this time. Let’s bank it!

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Anticipating future illness, patients freeze stem cells from own wisdom teeth

ATLANTA (CBS46) -The procedure was like any other at the office of Dr. Andrew Aiken, with one major exception: when the oral surgeon finished pulling four wisdom teeth from the mouth of 19-year-old Reed Dobbs, the teeth weren’t thrown away. They were placed in a storage box, to be shipped to a secure facility and frozen for decades to come. "I’d never even heard about this technology until Dr. Aiken told me about it," said Dobbs. "The technology is great, and I’m just really excited about it." The stem cells contained within his wisdom teeth could help cure a number of diseases the Georgia State University student might face. He has chosen to have those cells preserved as they are, from perhaps their healthiest stage in life, as an insurance policy against future medical conditions. His mother, Lisa Dobbs, learned about the offer, and chose to pay the roughly $700 up front, followed by fees to renew the storage of her son’s teeth. "I feel great, and every time I’ll pay the renewal, I’ll feel good about it as well," said Lisa Dobbs. In the Atlanta region, the service is being offered by a three-year-old company called Vault. Its founders, Adam Houtman and Jase Wrigley, believe the time is coming when most people will make an investment to preserve their own stem cells for use later in life. Houtman and Wrigley said their service is affordable, and could provide an avenue to stem cell preservation most people never knew they had. "We’re on the cusp of a medical revolution that’s going to change everything we do in medicine," said Houtman, CEO and co-founder of Vault. "I think using our own cells to treat ourselves, is going to become the standard of care," said Wrigley, co-founder of Vault. They’ve marketed their service largely through oral surgeons who remove wisdom teeth, because that procedure is typically performed at a time in the patient’s life when cells are at their peak of health. Houtman said the treatment is not a step toward immortality, but rather a way to alleviate some of the ailments that make like unpleasant at an older age. "What if I could retain all my faculties until old age, and not have to experience the leading causes of potential death," said Houtman. "That’s something I would like to explore. I would like to maintain my muscle tone until old age, my hips, my vision, even sense of taste, and smell." According to Dr. Franklin West, a leading stem cell researcher at the University of Georgia, adult stem cells could be used to help treat stroke, traumatic brain injury, and heart attacks. "I think stem cell technology is a paradigm changing technology," said West. "You could actually re-grow the bone or re-grow the hips and joints, and you can actually transplant them." Reed Dobbs hopes he never has to use the cells that have been frozen from his wisdom teeth. But if that day comes later in his life, he feels a unique sense of optimism about his treatment possibilities.
The Promise of Growing New Teeth

Dental stem cells could revolutionize treatment for patients who face extractions

By David Levin April 25, 2016

Losing teeth is part of childhood. For adults, however, missing molars or broken incisors require a manmade solution in the form of dentures or implants. Using dental stem cells to grow new teeth and jawbone would have advantages over existing tooth-replacement techniques, and could even be used to reconstruct a patient’s jaw after a severe injury or disease, according to a researcher at the Tufts School of Dental Medicine who is trying to do just that. Pam Yelick, G89, a professor of orthodontics and director of the division of craniofacial and molecular genetics, and her colleagues are developing ways to grow healthy new teeth and bone from dental stem cells—a type of “universal cell” that can morph into many different types of oral tissue. After harvesting the stem cells from healthy adult tooth pulp, Yelick’s team isolates them in the lab and gradually coaxes them into forming new tooth buds, the tiny clusters of soft tissue that eventually grow into a mature tooth. Their work looks promising. Over the past several years, Yelick and her research team have used these scaffolds to develop tooth buds, implanted them in pig jaws and watched them develop into early-stage adult teeth over the course of five months. It’s an encouraging sign, but she quickly notes that it will be years before we will be able to grow our own replacement teeth.

If you could implant living, vascularized teeth in the jaw, that could be a much better option than dentures or artificial implants, says Pam Yelick. Illustration: Stuart Bradford

Researchers use light to coax stem cells to repair teeth

Noninvasive laser therapy could radically shift dental treatment and lead to a host of broader clinical applications in regenerative medicine

Dr. David J. Mooney and Robert P. Pinkas from the School of Engineering and Applied Sciences (SEAS) at Harvard were able to successfully demonstrate the use of low-power lasers to trigger stem cells inside the body to regenerate lost tissue. This study along with multiple others paved way for the application of stem cells in regenerative medicine and restorative dentistry.

As mentioned earlier, a low-power laser was used to trigger the formation of dentin by the stem cells. Dentin, the hard tissue which is similar to bone makes up the bulk of the teeth. Their study was backed by multiple laboratory and animal models. The mechanisms involved in the process of tooth restoration were also highlighted. Mooney’s group used a non-traditional approach of not manipulating the isolated stem cells under lab conditions. Omitting the manipulation step helps overcome the regulatory and technical hurdles associated with clinical translation.

Dr. Mooney believes that “It would be a substantial advance in the field if we can regenerate teeth rather than replace them.”

Bone augmentation at the site of dental implants using mesenchymal stem cells

Often times, prosthetically ideal placement of dental implants is limited by the lack of sufficient alveolar bone. Osteoprogenitor and mesenchymal stem cells play a pivotal role in the overall regeneration of the bone augmentation procedure during dental implant placement. MSCs facilitate Guided bone regeneration (GBR) via the use of barrier membranes in regions with alveolar ridge deficiencies. This allows for the placement of implants at the desired angle. The stem cells suppress the inflammatory response by inhibiting lymphocyte proliferation and inflammatory cytokines and by promoting the recruitment of regulatory T-cells and anti-inflammatory cytokines. This provides a rather congenial atmosphere for osseous regeneration to take place.

Stem cells in periodontal regeneration

The periodontum is a set of specialized tissues that surround and support the teeth to maintain them in the jaw. Periodontitis is an inflammatory disease that affects the periodontum and results in irreversible loss of connective tissue attachment and the supporting alveolar bone. The challenge for cell-based replacement of a functional periodontum is therefore to form new ligament and bone, and to ensure that the appropriate connections are made between these tissues, as well as between bone and tooth root. One main aim of current research is to use different populations of stem cells to replicate the key events in periodontal development both temporally and spatially, so that healing can occur in a sequential manner to regenerate the periodontum.
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