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Bone tissue engineering in the oral and craniofacial regions

We are living in a very exciting era of remarkable advances in human life sciences. Basic knowledge gained at lab benches is transformed into innovative therapeutic approaches to many oral health diseases. With no doubt, one of the most promising fields is regenerative medicine/dentistry that is opening enormous possibilities for treatment of varied conditions requiring renewal of damaged, lost, maldeveloped, or aged tissues using cell cultivation and tissue engineering techniques.

J. Mao wrote six years ago: Stem cell research development will, over time, transform dental practice in a magnitude far greater than did amalgam or dental implants. Metallic alloys, composites and even titanium implants are not permanent solutions. In contrast, stem cell technology will generate native tissue analogs that are compatible with the patient's own. (Mao JJ, NY State Dental J, 2008)

A condition of bone tissue is one of the major issues in many fields of dentistry – oral and maxillofacial surgery, periodontics, endodontics, orthodontics, implantology and other specialties. Building of a bone is a primary goal of tissue engineering in the oral and craniofacial regions nowadays.

In the lecture, a history and biological properties of human stem cells, recent advances in induction of pluripotency in adult cells, and characteristics of human adult mesenchymal stem cells (for example, dental pulp stem cells - DPSC) will be covered. Inflammatory reaction and other factors influencing regeneration of tissues will be characterized in a context of possible clinical applications of stem cells and tissue engineering in dentistry. A special attention will be given to physiological conditions of cultivation of DPSC to obtain a sufficient number of cells that would retain their normal capacities to further multiply, differentiate and function after implantation in vivo. Examples of clinical applications will illustrate possible uses of autologous adult mesenchymal stem cells for regenerative treatments requiring bone tissue augmentation. It is exciting that, in our time, a new cellular treatment modality is being developed and applied especially in dentistry.

Biography

Mirek Tolar, MD, PhD, received his MD with honors at the age of 24 years from the 1st School of Medicine, Charles University in Prague, Czech Republic. He completed his PhD at the age of 29 years in the Institute of Physiology, Czechoslovak Academy of Sciences in Prague.

Tolar's research expanded from earlier tissue culture studies on nerve and muscle cell differentiation to his recent research focused on physiological ways of mesenchymal stem cell expansion in culture with the aim to preserve their normal functionality in the site of implantation in vivo. In addition to Czechoslovak Academy of Sciences in Prague, he conducted his research at the College of Physicians and Surgeons, Columbia University in New York, at Hyogo College of Medicine, Nishinomiya, Hyogo, Japan, and at several research laboratories at University of California in San Francisco. Dr. Tolar has over 50 scientific presentations, publications, invited and keynote lectures and held numerous visiting professorships. Recently, he gave courses in Kuwait, India, Nigeria and other countries on perspectives of tissue engineering and stem cells in dentistry. He established and is heading the Pacific Regenerative Dentistry Laboratory in the Dugoni School of Dentistry, University of the Pacific, San Francisco, CA, USA.

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