Willson Kwok, J Cell Sci Ther 2013, 4:4
http://dx.doi.org/10.4172/2157-7013.S1.024

OMICS Group Conferences
Accelerating Scientific Discovery

3rd World Congress on
Cell Science & Stem Cell Research
November 20-22, 2013 DoubleTree by Hilton Baltimore-BWI Airport, MD, USA

Engineering of a stem cell and nanotechnology-based bone graft substitute

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Estimated more than 700,000 bone grafting procedures are performed annually in the United States, with a growth of 13% per year and with about half of these procedures related to spinal fusion. Since these numbers easily exceed the number of available musculoskeletal donors, the discrepancy in the supply and demand of bone allografts has stimulated the development and sales of bone graft substitutes in the U.S. Our first aim is to review the currently available bone graft substitute materials in this $1.8 billion industry, including (1) allograft-based bone graft substitutes, (2) growth factor-based bone graft substitutes, (3) recombinant bone morphogenetic proteins, (4) ceramic-based bone graft substitutes, (5) polymer-based bone graft substitutes, and (6) cell-based bone graft substitutes.

The successful performance of bone graft substitutes depends on their ability to facilitate new bone formation through three biological processes: osteoconduction, osteoinduction, and osteogenesis. For instance, growth factor-based bone graft substitutes such as bone morphogenetic proteins (BMPs) induces previously undifferentiated stem cells, but their applications have been limited by the requirement for a superior tissue scaffold or delivery carrier. Our second aim is to unveil our latest development of a new bone graft substitute that will satisfy all these three biological requirements for successful new bone formation. The *in vitro* effects of this new bone graft substitute, which contains (1) an osteoconductive carrier containing denatured collagen and nanoscale hydroxyapatite, (2) an osteoinductive agent involving demineralized bone matrix (DBM), and (3) an osteogenic component using mesenchymal stem cells (MSCs) were evaluated.

Biography

Willson Kwok teaches Biology at the Frostburg State University. He received his bachelor degrees at the University of Hawaii, his M.B.A. and Ph.D. in Biology at the University of North Carolina. He is a registered Patent Agent with the USPTO. He worked as a Project Manager for a medical device company and as a Senior Engineer for a *Fortune 500* company. His main research interests are biotechnology, biomedical devices, biodefense, intellectual property and innovation management. He has published articles in leading U.S. journals such as *American Journal of Physiology* and presented in more than 15 conferences such as *Experimental Biology*.