World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:10, No:07, 2016

Cell Adhesion, Morphology and Cytokine Expression of Synoviocytes Can Be Altered on Different Nano-Topographic Oxidized Silicon Nanosponges

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Abstract : Osteoarthritis (OA) is a common disorder in rehabilitation clinic. The main characteristics include joint pain, localized tenderness and enlargement, joint effusion, cartilage destruction, loss of adhesion of perichondrium, synovium hyperplasia. Synoviocytes inflammation might be a cause of local tenderness and effusion. Inflammation cytokines might also play an important role in joint pain, cartilage destruction, decrease adhesion of perichondrium to the bone. Treatments of osteoarthritis include non-steroid anti-inflammation drugs (NSAID), glucosamine supplementation, hyaluronic acid, arthroscopic debridement, and total joint replacement. Total joint replacement is commonly used in patients with severe OA who failed respond to pharmacological treatment. However, some patients received surgery had serious adverse events, including instability of the implants due to insufficient adhesion to the adjacent bony tissue or synovial inflammation. We tried to develop ideal nano-topographic oxidized silicon nanosponges by using with various chemicals to produce thickness difference in nanometers in order to study more about the cell-environment interactions in vitro like the alterations of cell adhesion, morphology, extracellular matrix secretions in the pathogenesis of osteoarthritis. Cytokines studies like growth factor, reactive oxygen species, reactive inflammatory materials (Like nitrous oxide and prostaglandin E2), extracellular matrix (ECM) degradation enzymes, and synthesis of collagen will also be observed and discussed. Extracellular and intracellular expression transforming growth factor beta (TGF-β) will be studied by reverse transcription-polymerase chain reaction (RT-PCR). The degradation of ECM will be observed by the bioactivity ratio of matrix metalloproteinase (MMP) and tissue inhibitors of metalloproteinase by ELISA (Enzyme-linked immunosorbent assay). When rabbit synoviocytes were cultured on these nano-topographic structures, they demonstrate better cell adhesion rate, decreased expression of MMP-2,9 and PGE2, and increased expression of TGF-β when cultured in nano-topographic oxidized silicon nanosponges than in the planar oxidized silicon ones. These results show cell behavior, cytokine production can be influenced by physical characteristics from different nano-topographic structures. Our study demonstrates the possibility of manipulating cell behavior in these nano-topographic biomaterials.

Keywords : osteoarthritis, synoviocyte, oxidized silicon surfaces, reactive oxygen species
Conference Title : ICTERM 2016 : International Conference on Tissue Engineering and Regenerative Medicine
Conference Location : Paris, France
Conference Dates : July 25-26, 2016