

Enhanced Spinal Fusion by Tissue Engineering of Mesenchymal Stem Cell/ Tricalcium Phosphate Ceramics Composite – An Experimental Study with Non-Decorticated Posterior Spinal Fusion

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In conventional posterior spinal fusion surgery, limited source of autograft and excessive bleeding during harvesting of autograft and intra-operative decortication could lead to significant morbidity. We investigated the alternative procedure to enhance osteogenesis in posterior spinal fusion by mesenchymal stem cells (MSCs) in an animal model. Rabbit bone marrow derived MSCs were differentiated into osteogenic cells by osteogenic supplement (OS group) *in vitro*. The autogenous MSC derived osteogenic cells were then loaded on beta tricalcium phosphate ceramics (β -TCP) and implanted onto non-decorticated transverse processes of lumbar vertebrae L5 and L6 in rabbits. The cell-free β -TCP served as control (Control group). The implantation of autogenous iliac crest with decortication was used as positive control (Autograft group). The spinal segment samples were harvested at 7-week post-operation for detail evaluations. The microCT analysis showed that all samples in the autograft group were fused and incomplete fusion was found in the OS and control group. In comparing the OS and

control group, the gap distance between transverse processes in OS group (2.33 ± 1.51 mm) was significantly less than the control group (7.26 ± 0.27 mm). Moreover, the volume of fusion transverse processes in OS group were increased by 54.3% ($p < 0.05$). The tissue volume of the newly formed bone was also significantly higher in the OS group (2.3 fold at L5 and 3.6 fold at L6). Comparing with the autograft group, the volume of fusion of the transverse process in OS group was 16.1% greater than autograft group significantly. Under fluorescent microscopy, more active bone formation and remodeling was observed in the OS group. The polarized light microscopy showed the bony tissue at the mineralization front in OS group was less mature than the control group. In conclusion, the TCP composite seeded with differentiated MSC were found to be effective bio-complex in enhancing non-decorticated posterior spinal fusion.