Effects of Bioactive Glass Scaffold and BMP-2 in Segmental Defects

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Reconstruction of segmental defects in the load-bearing area has long been a challenge in orthopaedics. We have demonstrated the feasibility of a biodegradable load-bearing scaffold fabricated from poly(propylene fumarate)/tricalcium phosphate (PPF/TCP) loaded with bone morphogenetic protein-2 (BMP-2) to successfully induce healing in those defects. However, there is limited osteoconduction observed with the PPF/TCP scaffold itself. Furthermore, a recent review on BMP-2 revealed greater risks in radiculities, ectopic bone formation, osteolysis and poor global outcome in association with the use of BMP-2 for spinal fusion. The aims of this study were to evaluate the potential use of a more osteoconductive material 13-93 bioactive glass and the potential side effects of locally delivered BMP-2 on adjacent bones. 13-93 glass scaffolds were fabricated by indirect selective laser sintering and implanted into critical size defects created in rat right femurs with and without 10 micrograms of BMP-2. The X-ray and micro-CT results showed that bridging callus was found as soon as 3 weeks and progressed gradually in the BMP group while minimal bone formation was observed in the control group. As expected, stiffness, peak load and energy to break of the BMP group were all higher than the control group. Higher healing rates in the 13-93 group was found compared to the healing rate in PPF/TCP group evaluated in the past indicating a more osteoconductive nature of the 13-93 scaffolds. The scaffolds of both control and BMP groups were partially degraded after 15 weeks as seen in the histological images. For the effects of local BMP-2 delivery to adjacent bones, no statistical difference in the bone area, mineral content and mineral density was found between control and BMP groups. In

conclusion, a 13-93 bioactive glass scaffold with local BMP-2 delivery has been demonstrated for its potential application in treating large bone defects.

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