AbstractID: 9002 Title: Micro CT imaging evaluation for the scaffold-guided calvarial bone defects repair in small animal models

Purpose: In recent years, micro CT imaging systems have been emerged as a promising imaging technique for the tissue engineering applications. We report our research results in using a commercial micro CT imager to evaluate the bone defect repair in small animals.

Method and Materials: In this study, the animal model included Fischer 344 female rats. The surgery was performed at the top calvarial area and a circular-shaped hole with diameter of 8.0 mm was cut out. Human mesenchymal stem cells with a baculovirus expressing BMP-2 were engineered and implanted in the biodegradable scaffolds. These scaffolds were fabricated from polymers and then attached to the critical-size area in the rats. In the experiments, there were three imaging groups including a control group for comparisons. A period of 12 weeks was scheduled to complete the micro CT imaging experiments. The imaging modality was a commercial SkyScan 1076 micro CT system. Mathematical methods, including density slice technique, were applied to quantify the bone regeneration progress.

Results: Based on our preliminary analysis from the volumetric images reconstructed from the micro CT projections, significant mineralization can be detected at week four and full bony bridging in the critical-size areas can be observed at week 12. The images were acquired at the settings of 80 kVp for the x-ray energy, 124 μA for the current, 316 ms for the exposure time, and 360 projections for one full circular rotation.

Conclusions: We have succeeded in using the micro CT imaging technique to quantify the scaffold-guided bone repair progress in a small animal model. Our images showed that the full bony bridging can be observed at the week of 12. The results indicated that the feasibility of future potential clinical applications of baculovirus-engineered mesenchymal stem cells in human bone regeneration.