Bone-like Scaffold for Vertical and Horizontal Ridge Augmentation

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Objectives
Active endogenous cell recruitment into the surgical site and dwelling are essential for successful bone regeneration. We examined the feasibility of developed bone-like scaffold that has superior absorption and retention capability of cells to apply for the repair of critical sized bone defect, such as vertical ridge augmentation. The biogenic capability and feasibility was evaluated via in vitro and in vivo experiment.

Methods
For the in vitro test, a bridge-shaped scaffolds (3cm-height X 4cm-length: total length is 10cm) were fabricated by template coating technique. For the in vivo test, a cylinder shaped scaffolds (8mm-diameter X 5mm height) were fabricated with same technique. The uniqueness is that the scaffold has micro-channels (25-70 μm) within each trabecular to generate capillary action, ready to absorb endogenous cells with marrow elements. This capillary action responsible for the cells migration for long distance. A saturation into scaffold and cellular response was evaluated using MC3T3 pre-osteoblast cell line in 6 well plate for in vitro study. The scaffolds were implanted in dog mandible for in vivo study. Cells hosting and migration throughout the scaffolds were investigated. The feasibility of bone regeneration also investigated.

Results
Ingression of cell suspension through the scaffold. For a clear observation of the suspension movement, the media was stained with Stevenel’s Blue. The front of the suspension was reached to the end of the other side of scaffold within 1 minute 40 seconds along with micro-channels. A large amount of the suspension was followed thereafter. Pioneers cells were reached to the end of scaffold within 100 seconds after placed the scaffolds in the culture plate. Within 5 minutes, the scaffolds were completely saturated with cell suspension. Cells were journeyed 10 cm throughout the scaffold by capillary action via micro-sized tube-like structures in the each trabecular.

Conclusion
The findings of study suggest that the bone-like scaffold capable high-volume of absorbing and retaining cells can address the major barriers of insufficient bone marrow infiltration into the synthetic constructs and incomplete bone regeneration in large defects.