A 3D-Printed Bone Metastasis Resection Model for Local Therapeutic Implant Screening to Prevent Recurrence

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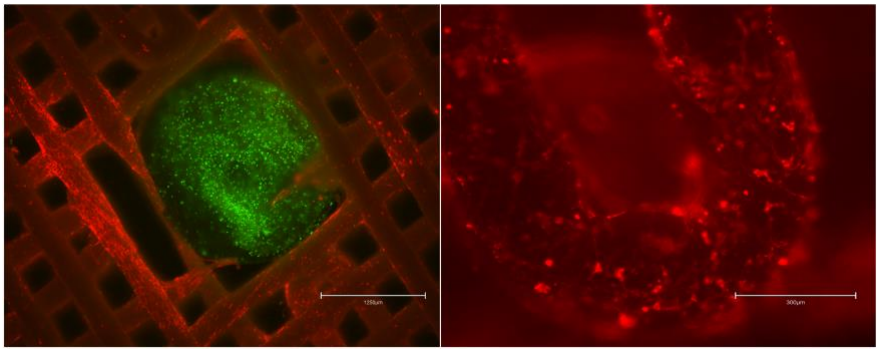
INTRODUCTION AND OBJECTIVES: Critical-sized defects created by the surgical resection of bone metastases are often filled with bone substitutes, however, hidden tumor cells hidden often drive cancer recurrence. Bone-like scaffolds are often used to investigate bone-tumor interfaces and perform drug screening. Our aim is to develop a 3D-printed bone-like scaffold with a hydrogel tumor core to assess the recurrence of tumor cells following the resection of the tumor core and the insertion of drug-loaded implants for local drug release.

METHODS: Cylindrical scaffolds were 3D printed with 60/40 Lactoprene 7415/β-TCP material (Poly-Med Inc., USA) with 40% infill density in a grid pattern. Scaffolds were seeded with IMR-90 mCherry fibroblasts and hydrogel tumor cores were prepared with MDA-MB-231/GFP breast cancer cells in two different compositions of an alginate-gelatin hydrogel and implanted in the center of the scaffolds. Fluorescence microscope images were taken at multiple time points to assess cell migration and metabolic activity profiles will be determined, followed by FACS analysis.

RESULTS: IMR-90 cells were seeded onto scaffolds and proliferated over the course of 3 weeks. A 1% alginate/7% gelatin hydrogel allowed for more tumor cell migration from the tumor core to the scaffold than a 3% alginate/7% gelatin hydrogel 3 weeks after implantation. We anticipate that with the removal of the tumor core and insertion of drug-loaded implants, the tumor cells will be inhibited compared to control scaffolds.

CONCLUSION: We anticipate the development of a bone tumor resection model that will allow for therapeutic implant screening in a physiological bone-tumor model.

Scaffold with tumor core | IMR-90 cells seeded on scaffold



A3G7 Hydrogel – 3 weeks after implantation | A1G7 Hydrogel – 3 weeks after implantation