Stem Cell Behavior and Osteogenic Differentiation on Plant-Derived Scaffolds

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Suitable vascular and porous structures are critical in tissue engineering scaffolds. Through years of convergent evolution, the geometry of plant and animal tissues has become increasingly similar in this regard. Furthermore, plant material is vastly abundant and accessible. Three different porous tissues (Apium graveolens, Daucus carota, Asparagus officinalis) were chosen since their construction resembled that of cancellous bone. Material from these plants was prepared through an adapted decellularization procedure. Image analysis of a viability assay indicated that these materials were biocompatible and permitted adhesion. After a longer proliferation period, the data suggested that cell behavior varied predominantly based on the mechanical and topographical characteristics of the scaffolds. Based on image analysis techniques, the interaction between the mesenchymal stem cells (MSCs) and the plant-derived substrates was assessed. These analyses demonstrated that plant species-dependent differences significantly affected MSC behavior in culture. The Apium graveolens tissue demonstrated the highest rate of MSC proliferation and the most conducive cell behavior for osteogenic differentiation due to its pore size and construction. Furthermore, the unique topographical qualities of plant scaffolds promoted osteogenic differentiation. Overall, the presented results indicate that decellularized plant tissue could serve as a substrate for bone tissue regeneration and additionally establishes a precedent for cell behavior in plant-derived substrates. Ultimately, these results may allow future research to leverage the biodiversity of the plant kingdom for further investigation in tissue engineering.

Awards Won:
First Award of $5,000