The mechanical properties and cell cultural response of melt electrospun scaffolds with controlled offset and gradient pore size

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Abstract

Scaffolds made by the melt elctrospinning writing (MEW) technique have proven their value for tissue engineering applications. This solvent free manufacturing method has the ability to produce customisable defined 3D printed scaffolds with a high level of control over the geometry, size and distribution of pores and fibre diameters.[1] Using a porous gradient architecture which mimics the properties of natural bone ECM provides an environment for higher cell infiltration and nutrient fluids to the structure, along with the ability to withstand external loading stress. [2]

In this study, we designed three-dimensional ε-poly caprolactone (PCL) scaffolds of defined architecture with 1) different pore sizes, 2) various offset values (30%, 50%) and 3) gradually increasing pore sizes along the longitudinal direction (from 250 to750 μm), which were fabricated by melt electrospinning writing technique. Surface bioactivity of the scaffolds was enhanced by calcium phosphate coating which promoted cell attachment and proliferation.
The fabricated scaffolds were assessed for physical properties, including electron microscopy, μ-CT examination, and bending modulus. Compared with the simple structures, the gradient and offset scaffolds showed superior physical improvements, such as higher bending modulus. Cell viability, alkaline phosphatase (ALP) activity and expression of osteogenic and bone-specific proteins were assessed using, ALP activity showed superior osteoblast differentiation in the 50% offset and gradient structures.
The pore size gradient and offset scaffolds can be good candidates for in vivo bone formation studies.

References

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