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Biomimetic microchannel network with functional endothelium formed by sacrificial electrospun fibers inside 3D gelatin methacryloyl (GelMA) hydrogel models

Key words:

Biomimetic scaffold; Photocrosslinking; Microchannel network; Tissue engineering; Artificial microvascular

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Fabrication and characterization of sacrificial electrospun fibers

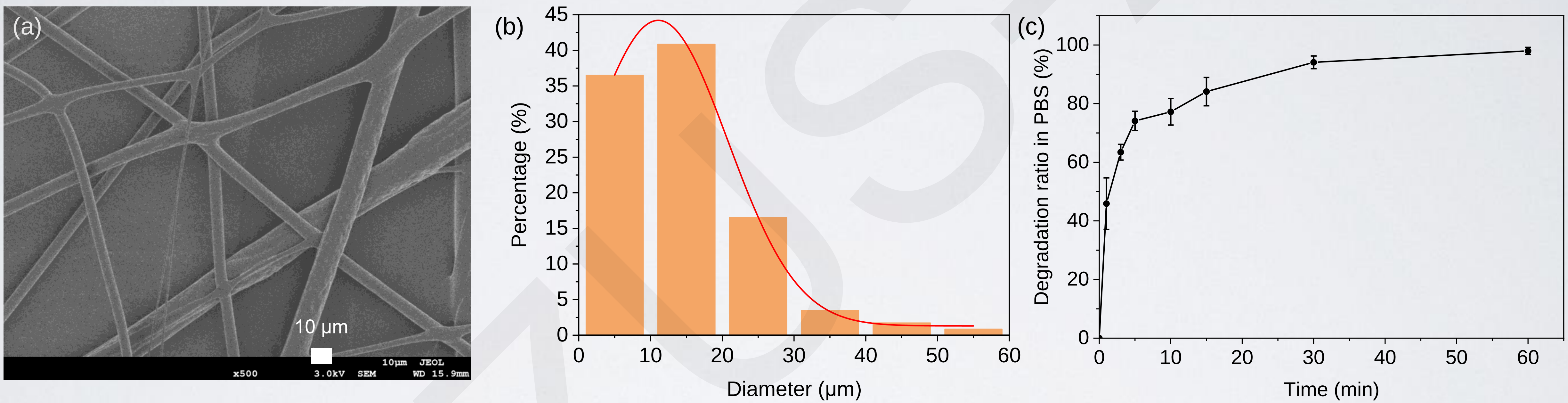

Fig. 1 Fabrication and characterization of PVA fibers: (a) SEM images of PVA fibers to study the surface of PVA fibers to mimic the capillary structure. Scale bars represent 10 μm; (b) the average diameter of PVA fibers; (c) degradation ratio of PVA fibers in PBS at room temperature

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Fabrication of microchannel GelMA hydrogel scaffolds

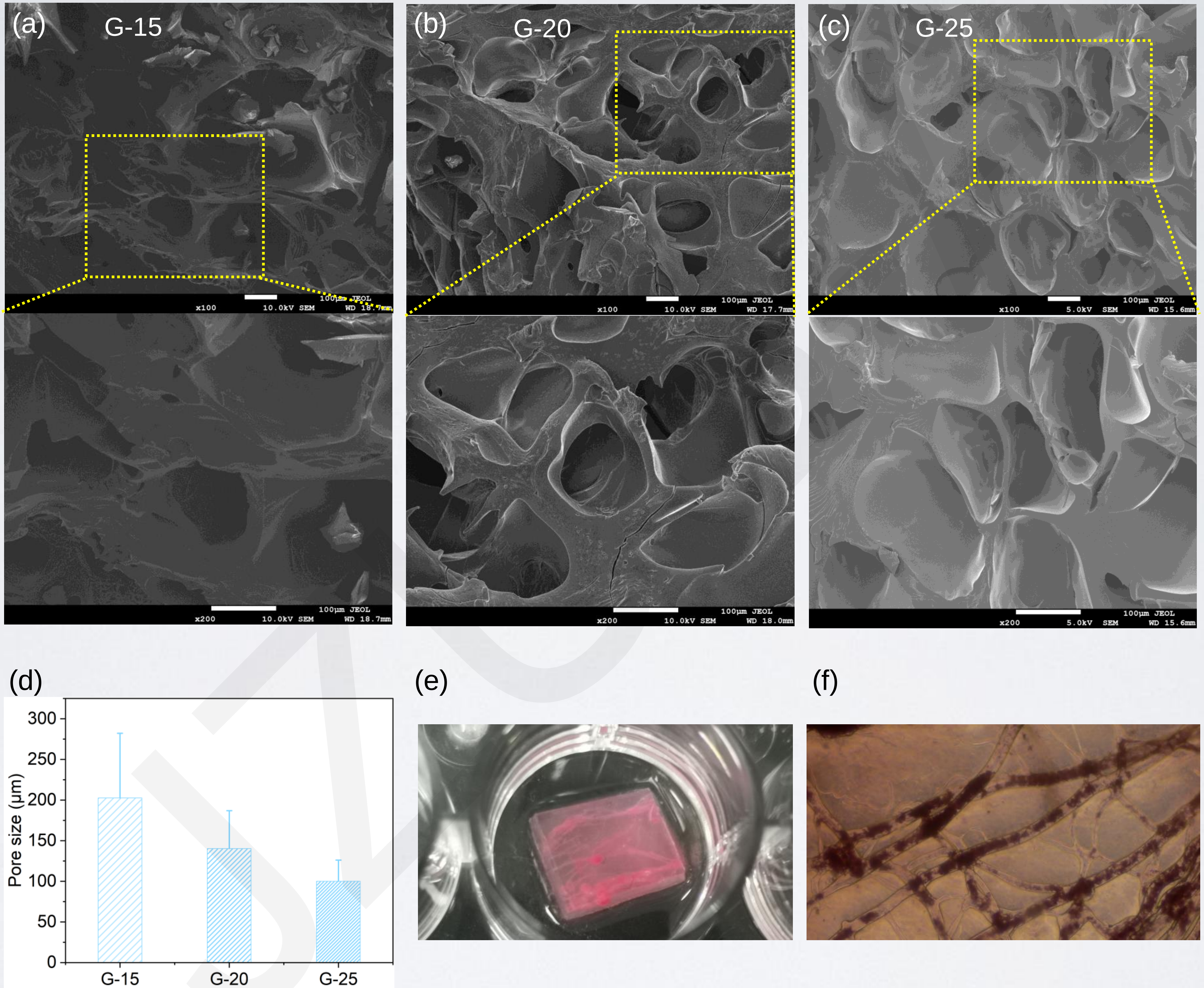

Fig. 3 Fabrication and characterization of microchannel GelMA hydrogels: (a), (b) and (c) SEM images of GelMA hydrogels. Scale bars represent 100 μm; (d) quantification of GelMA hydrogel porosity from scanning electron microscopic images as a function of GelMA concentration; (e) images of microchannel network dye infusion; (f) microscopic images of microchannel network dye infusion

Effects of scaffold surface and intra-scaffold microchannel on endothelial tube formation

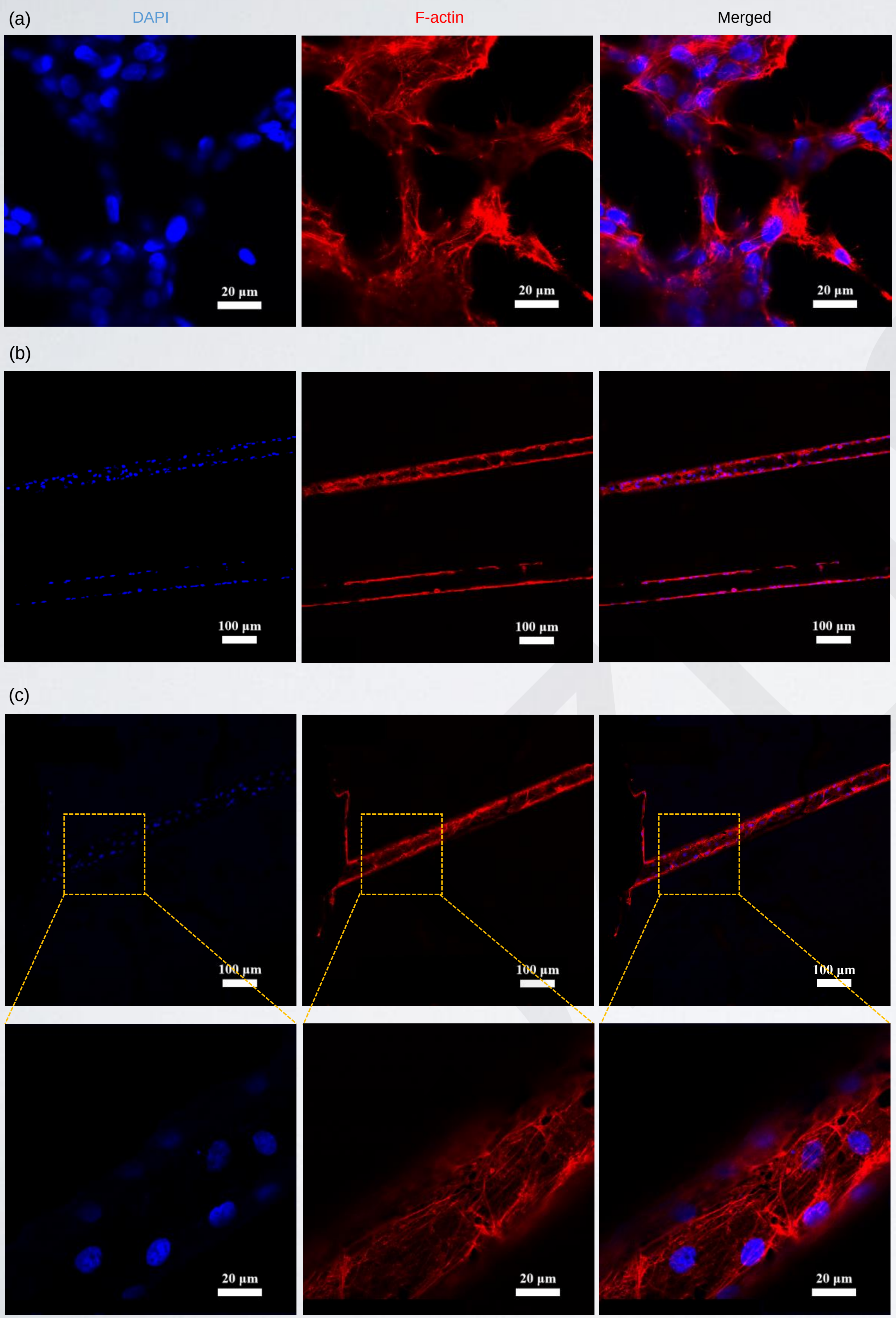

Fig. 7 Effects of intra-scaffold microchannel networks on endothelial tube formation. CLSM images after immunofluorescence staining of the nucleus (blue) and F-actin (red) of the endothelial monomolecular layer on the GC-20 scaffold surface (a), on the lumen of the microchannel in the GC-20 scaffold: near the central part of the scaffold (b) and near the edge of the scaffold (c) (magnification 10, 40, 63×)

Perspectives and Research Priorities

Research Priorities:

- For the first time, the fiber material with a diameter of > 10 μm was successfully prepared by electrospinning technology as a sacrificial material for the formation of a microchannel network
- By repeated extrusion, microchannels and cavities were successfully created in high-concentration GelMA hydrogels, thereby creating microvascular-like channels
- Successful formation of endothelial cell monolayer in microchannel lumen, and the effects on the activity, proliferation, morphogenesis and vascularization of HUVECs on the surface and scaffold of 3D hydrogel scaffold were studied.

This study presents a method for the preparation of 3D hydrogels embedded within a mimetic branching microvessel that mimics the native tissue structure of ECM. By electrospinning in the microchannel-containing mimetic tissue structure, the scaffold with microporous channels ensures the permeability of the final structure to achieve a high-resolution scaffold structure at the micrometer scale to facilitate the formation of endothelial cell monomolecular layers by HUVECs.