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Biomimetic Design, Modeling and Manufacturing of 3D Liver Tissue Construct with Optimized Vascular-like Hierarchical Channel Network

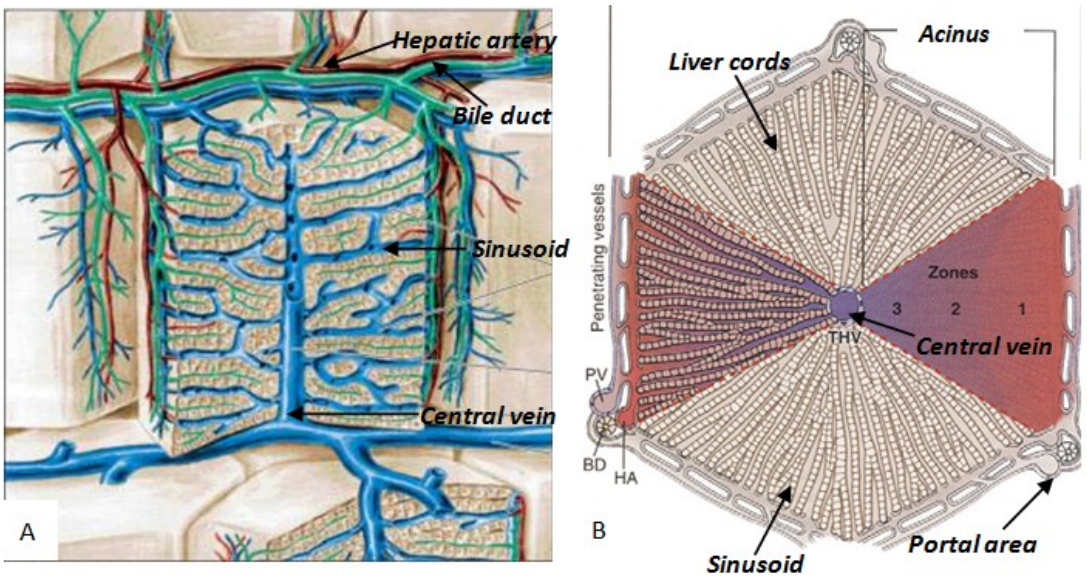

Fig.1. Liver anatomy A: Architecture of liver lobule [40], B: Zonal distribution of liver acinus

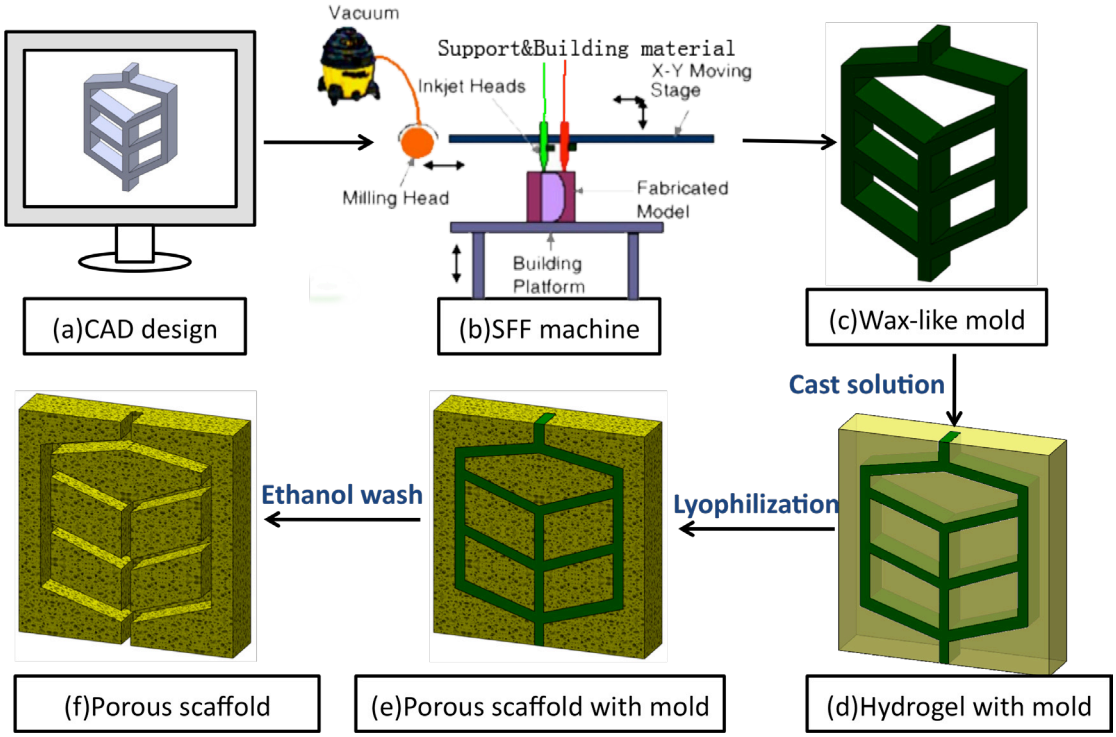

Fig.2. Illustration of scaffold fabrication processes by structured porogen and lost-wax molding method: (a) CAD design of mold structure (b) SFF machine used to produce mold; (c) wax-like mold as porogen; (d) cast solution into the porogen cavity; (e) porous scaffold with mold embedded inside; (f) after removing the wax-like porogen a porous scaffold with fine structure is formed.

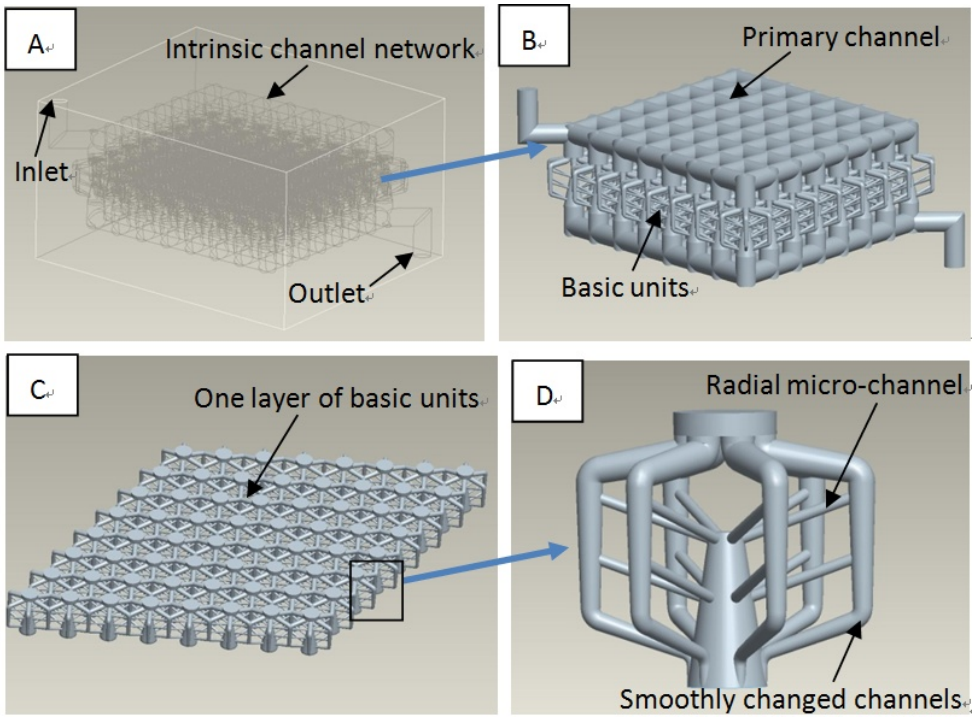

Fig.3. Structure of liver scaffold (directional micro-pores are not shown here), A: Perspective view of scaffold with one layer basic units; B&C: Channel structure inside scaffold, D. One basic unit of channel.

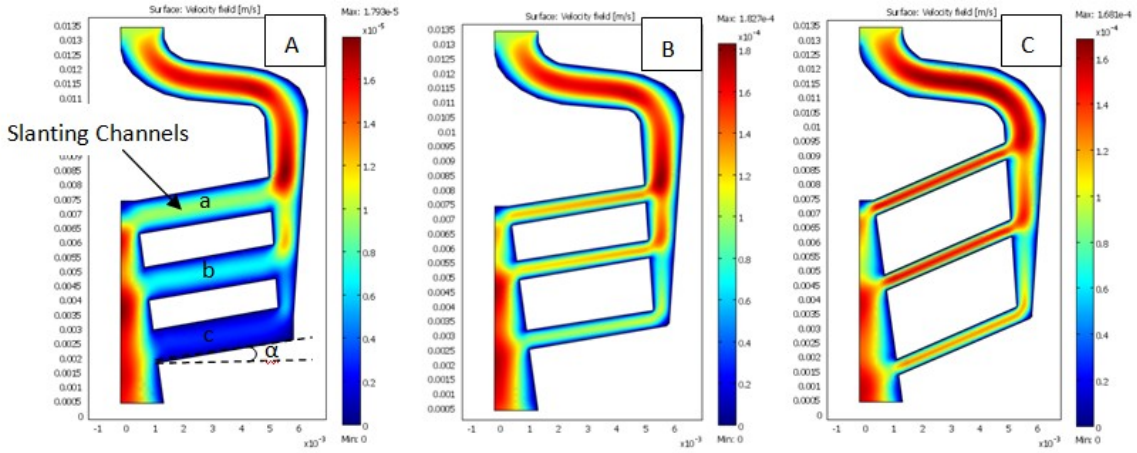

*Fig 4. Velocity field inside the channel with different diameter (**D**) of the slanting channels (a, b, c) and angle (α) between slanting channel and horizontal direction, A. **D=1mm, α=15°**, velocities in three slanting channels are low and un-uniform (average velocities: V_a=9.5*10^{-6}m/s, V_b=6.8*10^{-6}m/s, V_c=2.8*10^{-6}m/s), B. **D=0.5mm, α=15°**, velocities are relatively high and uniform (average velocities: V_a=1.3*10^{-4}m/s, V_b=1.2*10^{-4}m/s, V_c=1.0*10^{-4}m/s), C. **D=0.5mm, α=30°**, velocities are even higher than in structure B (average velocities: V_a=1.5*10^{-4}m/s, V_b=1.4*10^{-4}m/s, V_c=1.2*10^{-4}m/s),*

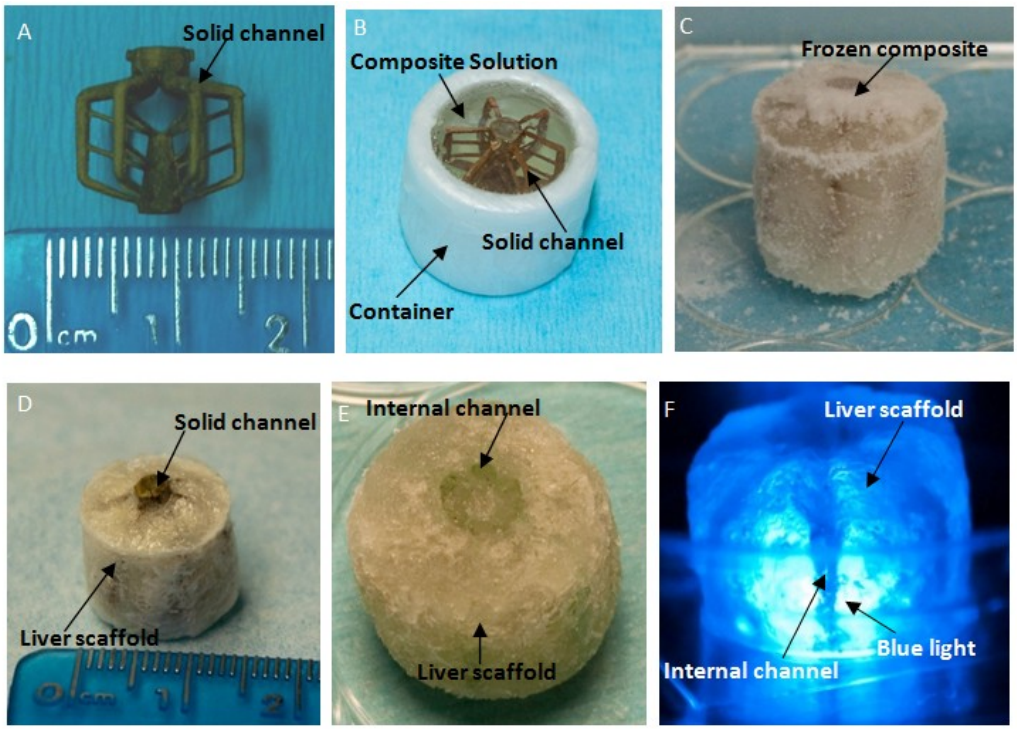

Fig. 5. Fabrication process: A. Solid channel, B. Solid channel in container filling with composite solution,, C. Frozen composite, D. Porous scaffold with solid channel inside, E. Porous scaffold with inside channel structure. F: A blue light from bottom of the scaffold reveals the internal channel structures

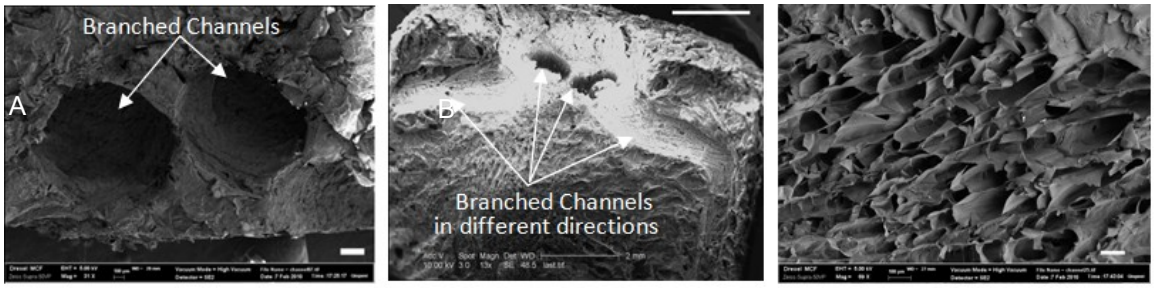

Fig.6. SEM pictures of liver scaffolds with pre-defined channels, Cross-section (A, bar: 100μm) and perpendicular section (B, bar: 2mm) of the channels, C. Micro-pores inside the scaffold (bar: 100μm)

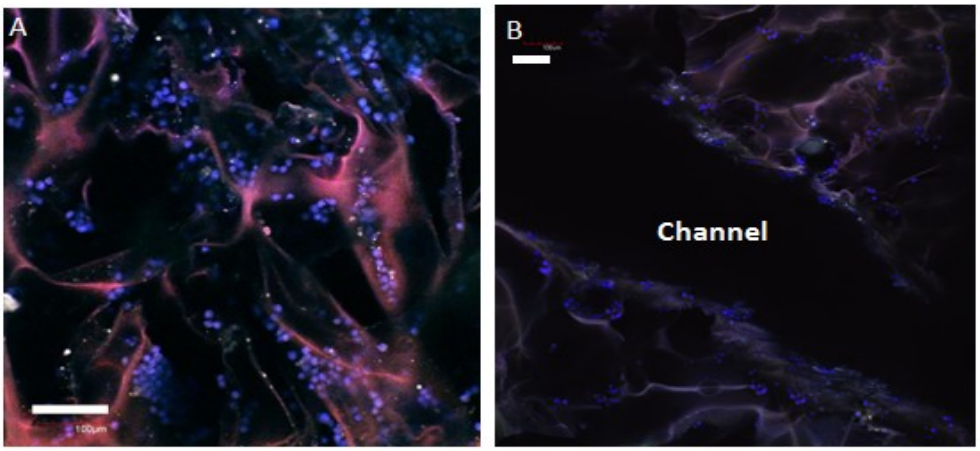

Fig. 7. HepG2 on chitosan/gelatin scaffolds with channels (blue nuclei stained with bisbenzimide): 3 days: evident cell growth was found both at the bottom (A) and the center (B) of scaffolds, (Bar: 100μm)