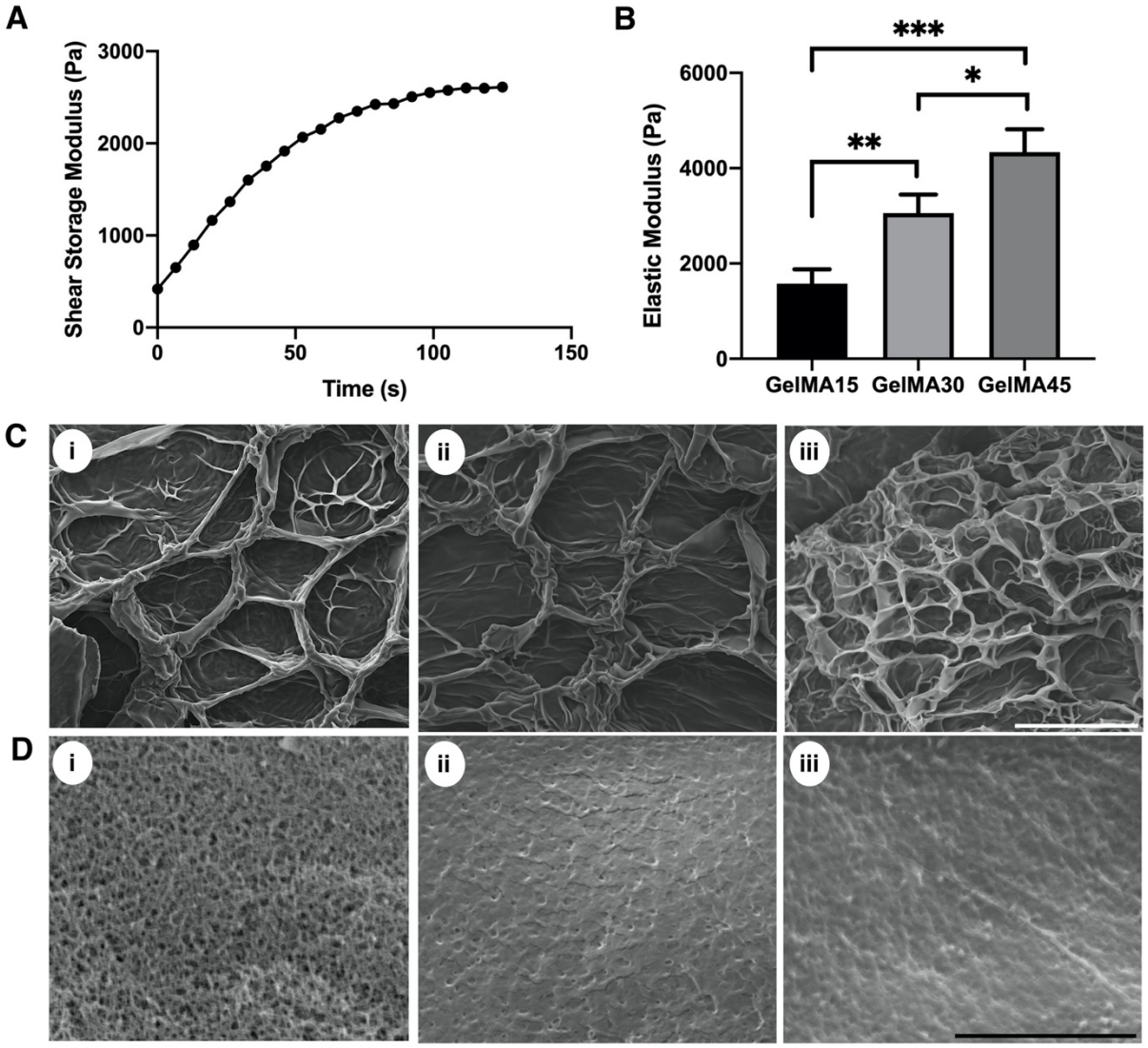
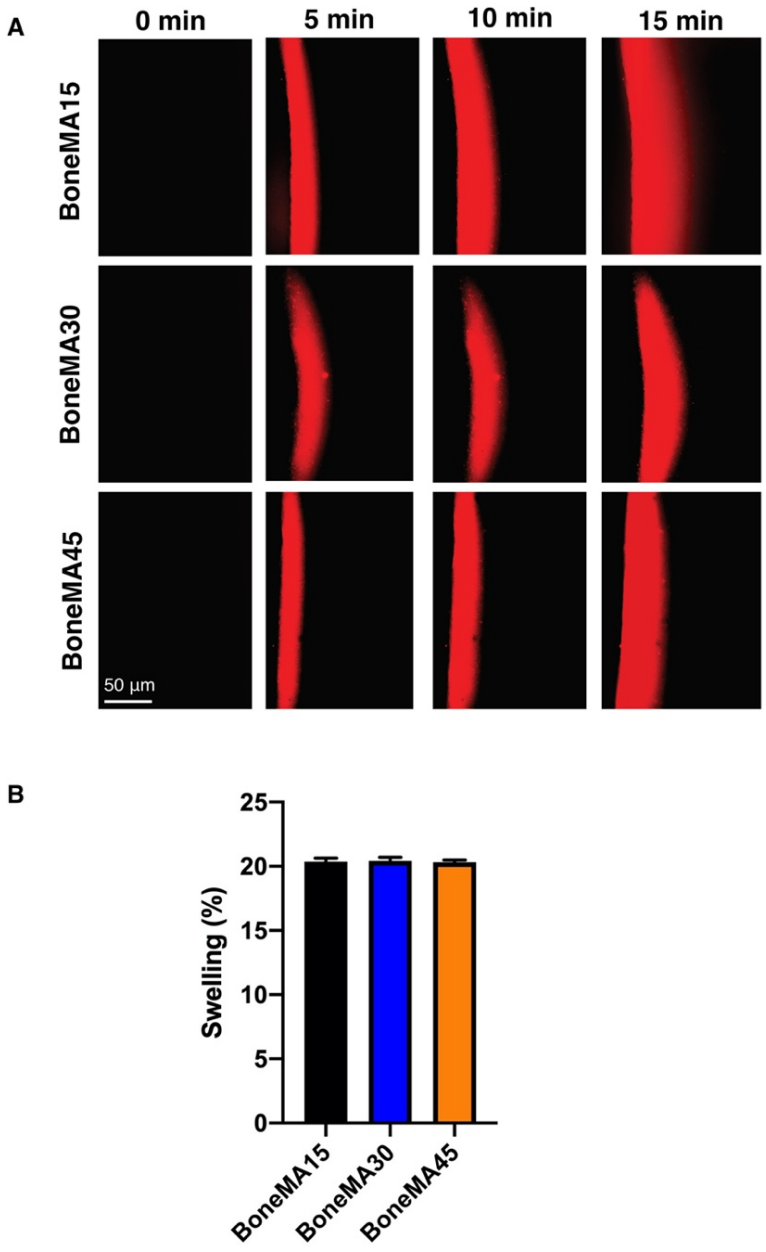
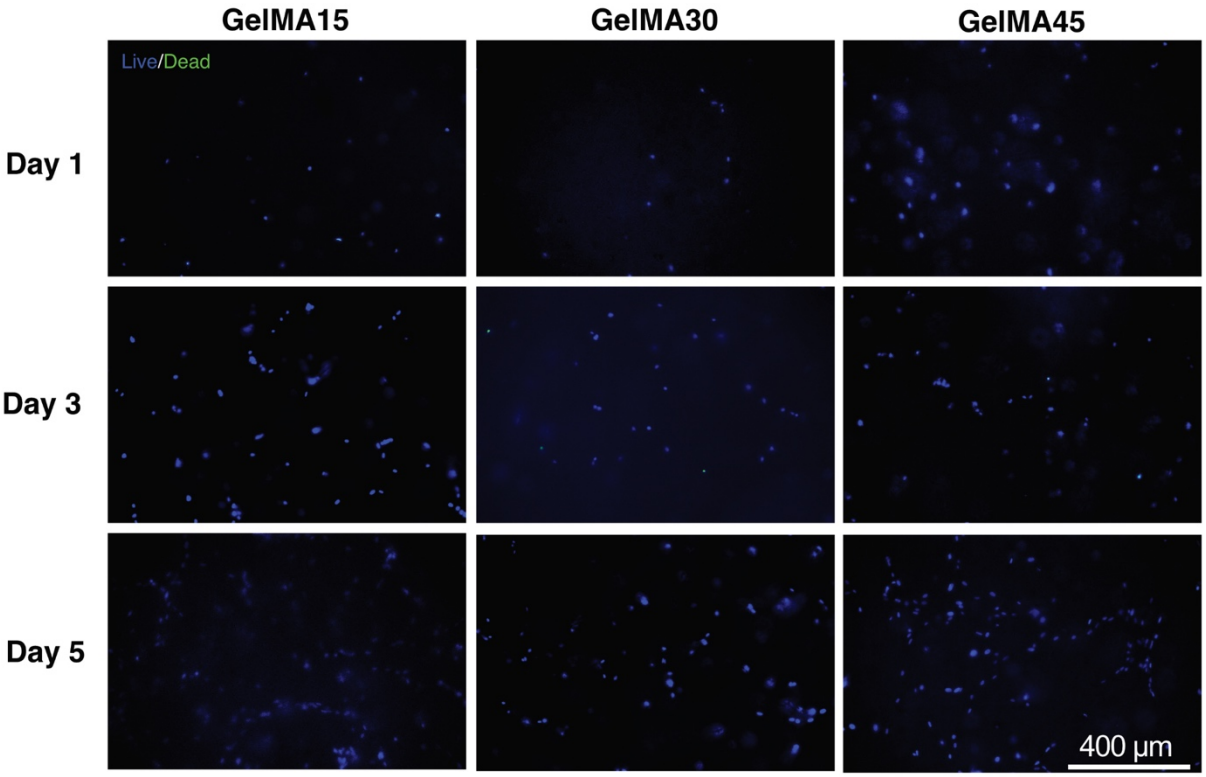


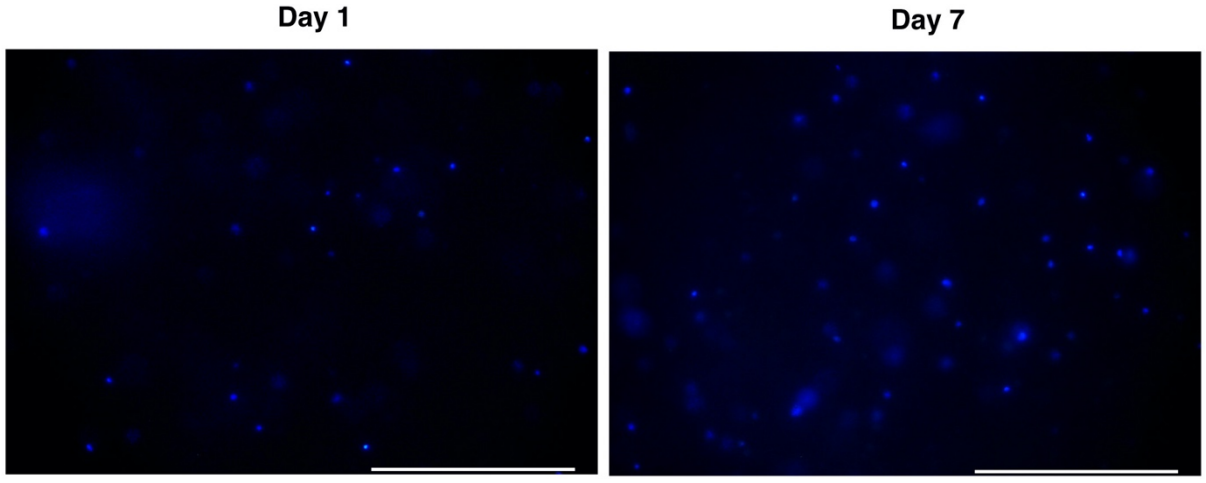

**Supplementary Figure S1.** Physical characterization of GelMA. (A) Real-time in situ photorheometric analysis showing the shear storage modulus of GelMA as a function of time. (B) The elastic modulus of GelMA hydrogels increased as a function of crosslinking duration starting from 1.5 kPa at 15 seconds to 3 kPa and 4.3 kPa at 30 and 45 seconds, respectively. Meanwhile, apparent pore size as evidenced by SEM images of (C) freeze dried and (D) critical point dried GelMA samples showed a decrease in pore size from (i) GelMA hydrogels crosslinked for 15 seconds to those that were crosslinked for (ii) 30 and (iii) 45 seconds. (Scale – 5 μm) (*$p < 0.05$; **$p < 0.005$; ***$p < 0.001$).



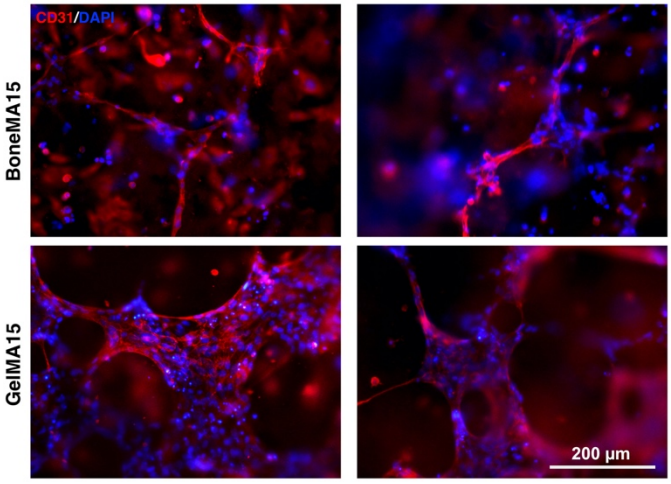

**Supplementary Figure S2.** (A) Apparent diffusion of rhodamine dye, as measured by its fluorescence, was higher in BoneMA hydrogels polymerized for 15 seconds in comparison with those that were polymerized for 30 and 45 seconds, suggesting that the less crosslinked hydrogels were more permeable. (B) The equilibrium swelling ratio was showed that the swelling properties of all the samples were identical over the given time period.



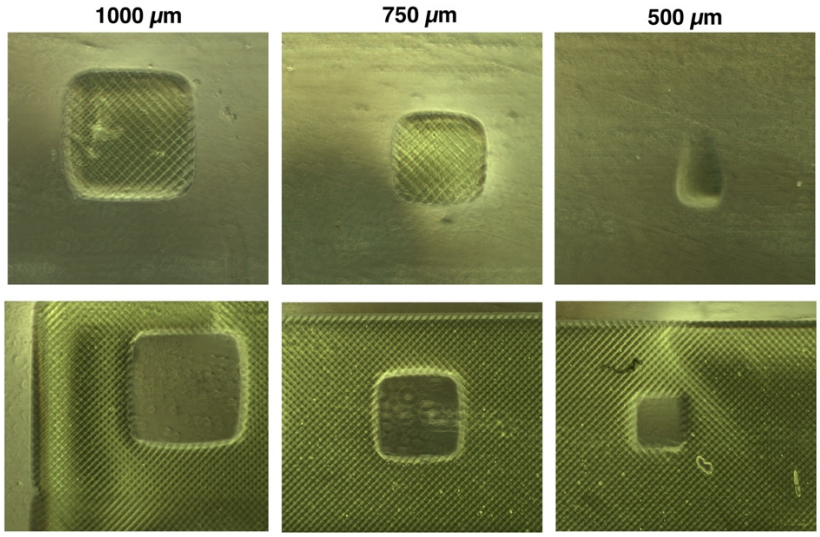

**Supplementary Figure S3**. Cytocompatibility of GelMA hydrogels. Representative images of hDPSCs encapsulated in GelMA hydrogels crosslinked for 15, 30, and 45 secs and stained for live (blue) and dead (green) cells at 1, 3 and 7 day time points showed a high degree of viability across all conditions and time points. Scale bar - 400 µm




**Supplementary Figure S4**. Representative images showing the proliferation of HDPSCs in BoneMA30 after 7 days of encapsulation. The cells were stained with NucBlue® reagent. Scale bar - 400 µm




**Supplementary Figure S5.** CD-31 immunostaining of the vascular networks in BoneMA15 and GelMA15 after 3 days. In presence of excess VEGF, the vascular networks continuously remodeled, and the remodeling was directly dependent on the crosslinking time of the hydrogels. GelMA15 showed more active remodeling than BoneMA15 with formation of very thick vasculature.




**Supplementary Figure S6.** Both positive and negative features ranging from 500 - 1000 µm in width were printed using BoneMA after a crosslinking time of 45 seconds. The resolution for the negative was better than positive for the 500 µm square print.

## Supplementary methods

*S1. Preparation of gelatin methacryloyl (GelMA)*

Gelatin methacryloyl (GelMA) was used as a control to compare against the biological properties of BoneMA. GelMA was synthesized as per the protocol described by Nichol *et al.* [19]. Porcine skin type A gelatin (10% w/v) (Sigma, St Louis, MO, USA) was dissolved in Dulbecco's phosphate buffered saline (DPBS, Sigma) warmed to 50 °C to which, 8% (v/v) methacrylic anhydride (Sigma) was added dropwise and allowed to react for 2 h. Next, the solution was diluted 5x times with DPBS and dialyzed with 12-14 kDa dialysis tubing against warm distilled water (45 ± 5 °C) for 5 days. The warm water was changed two times a day for 5 days. The resulting methacrylated prepolymer was lyophilized and stored at room temperature until further use. For GelMA sample synthesis, GelMA was crosslinked for 15 seconds, 30 seconds, and 45 seconds using the bioprinter as described previously, and the resultant constructs are identified as GelMA15, GelMA30, and GelMA45 respectively. The GelMA samples were treated similarly to BoneMA for SEM and live/dead analysis.