High-throughput functional toxicity screening with iPS-cardiomyocyte and hepatocyte spheroids by magnetic 3D bioprinting

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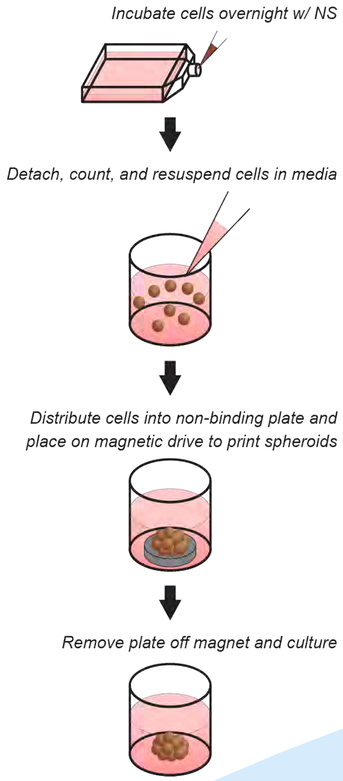
Summary

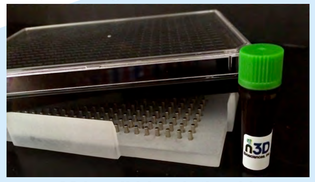


- 3D cell culture can recreate native tissue environments
- Current products on the market have technical issues that limit their use for high-throughput screening
- Magnetic 3D bioprinting works by magnetizing cells with NanoShuttle (NS), then printing them with magnetic forces in CELLSTAR® cell-repellent plates
- This platform escapes limitations of others by being reproducible, fast, easy to use, and adaptable for high-throughput

Advantages

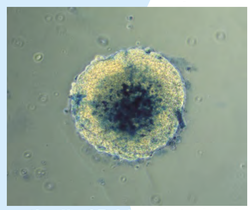
- Rapid spheroid formation (<24 h)
- Unattached spheroids with CELLSTAR® cell-repellent plates
- Magnetized spheroids easy to hold down while removing liquids
- Can be scaled down in size for 384-, 1536-well formats
- Can print, culture, stain, and image spheroids in same plate
- Non-specific to any cell type
- No effect of NS or magnetic field on cell viability
- No interference of NS on any endpoints (fluorescence, qRT-PCR)
- No special equipment/media

Magnetic 3D bioprinting is the ideal platform for high-throughput 3D cell culture



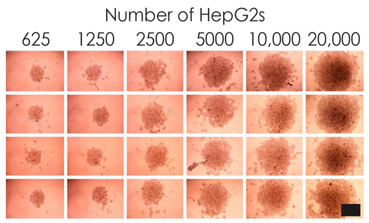
384-well bioprinting kit

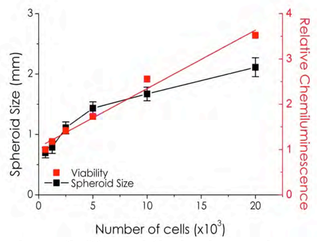
CELLSTAR® Cell-repellent 96- and 384-well plates



Magnetically 3D bioprinted spheroid on CELLSTAR® Cell-repellent surface

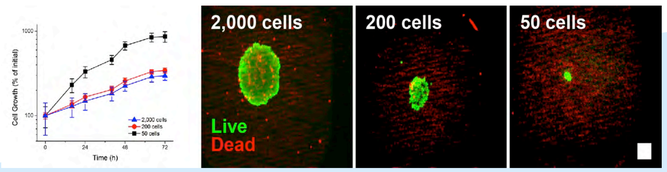
Reproducibility





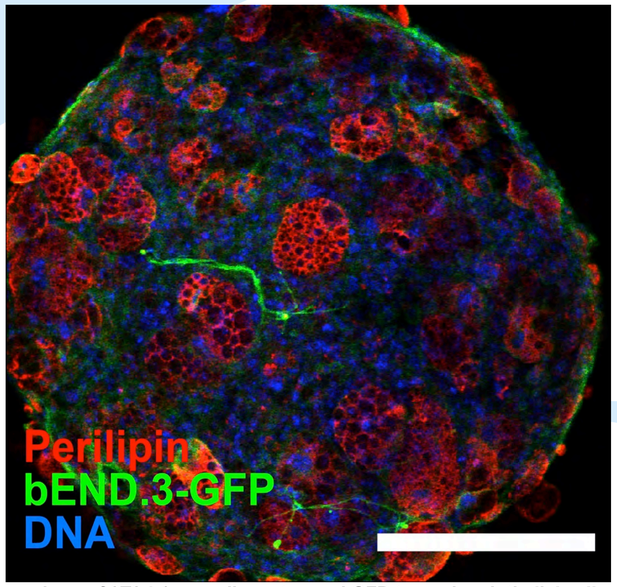
HepG2 spheroids printed at various cell numbers (left), and their size and viability (CellTiter-Glo, Promega) (right). Note the reproducibility of the spheroid sizes. Scale bar = 500 µm.

Viability



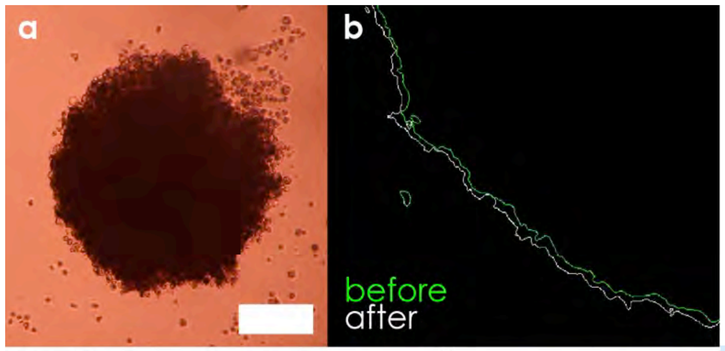
Viability of PC3 prostate cancer spheroids of 2,000, 200, and 50 cells measured by RealTime-Glo (left) and live/dead staining (right). Scale bar = 250 µm.

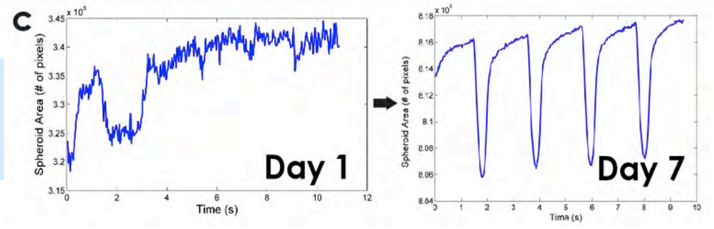
Co-culture



Adiposphere of 3T3-L1 pre-adipocytes and GFP-tagged endothelial cells (green) stained for perilipin (red) and counterstained for nuclei (blue). Scale bar = 100 µm.

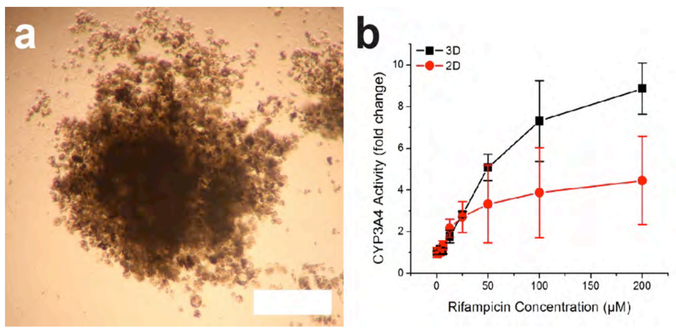
Cardiomyocytes





(a) iPS-cardiomyocytes formed a competent spheroid that beat in the 3D environment, and through (b) image tracking, beating patterns could be recorded. The beating of these spheroids matured from an asynchronous pattern (c) to a characteristic beating pattern (d). Scale bar = 500 µm.

Hepatocytes



(a) iPS-hepatocytes formed a competent spheroid (10,000 cells/well). After 7 d of culture and 3 d of exposure to rifampicin, CYP3A4 activity was induced, and to a higher magnitude than in 2D (72,000 cells/well). Scale bar = 500 µm. Error bars represent standard error.