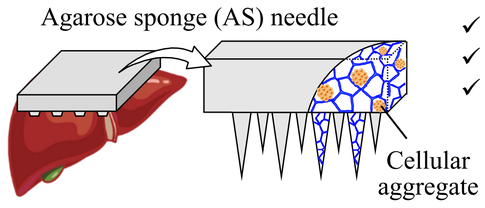
Cell-adhesive and non-adhesive composite material for stable organoid formation

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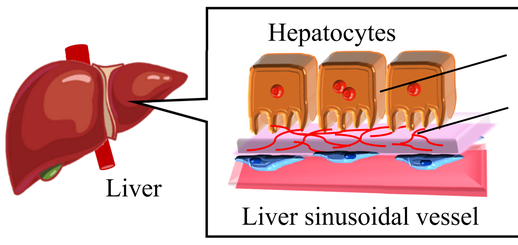
Background

Detachable implantation device (needle device)



- ✓ Cell aggregation
- ✓ Maintenance of functional expressions
- ✓ Minimally invasive approach

Early cell-ECM adhesion is absent.



Cell-cell adhesion

Cell-ECM adhesion

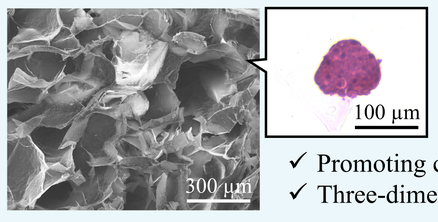
(Collagen, fibronectin, laminin, proteoglycans, etc...)

Multiple cell adhesion patterns are important for three-dimensional organization and functional expressions.

Purpose

Development of Fiber Immobilized Sponge (FIS)

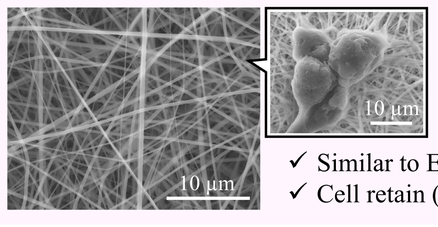
Agarose sponge (AS): non-cell adhesive property



HE staining image of primary rat hepatocyte tissue (spheroid)

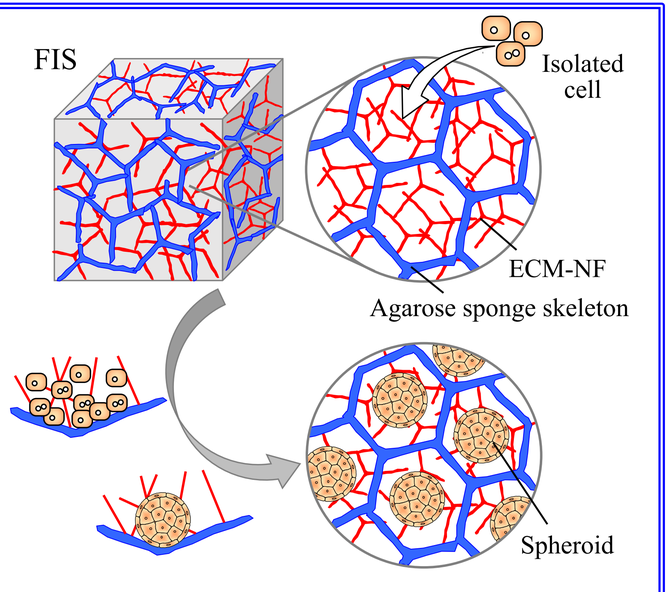
- ✓ Promoting cell aggregation
- ✓ Three-dimensional arrangement

ECM nanofiber (ECM-NF): cell adhesive property



SEM image of primary rat hepatocyte

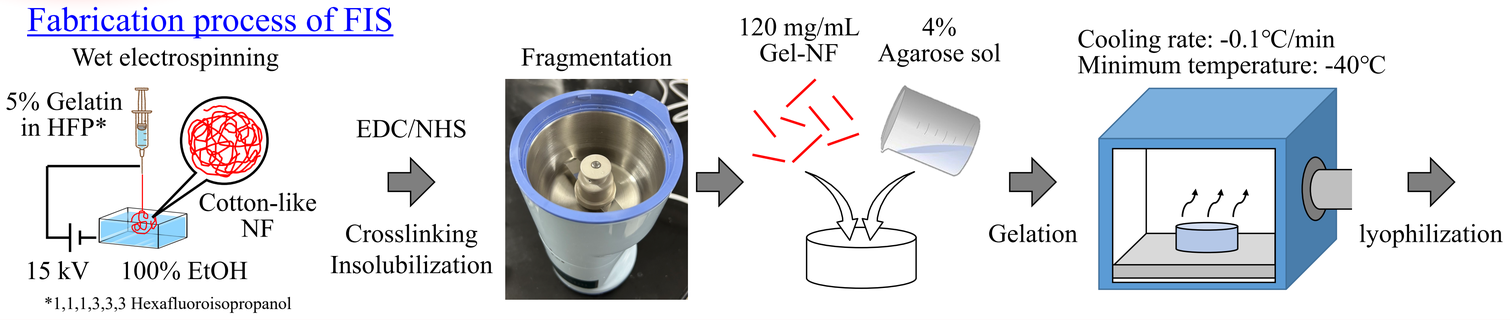
- ✓ Similar to ECM
- ✓ Cell retain (cell-ECM adhesion)



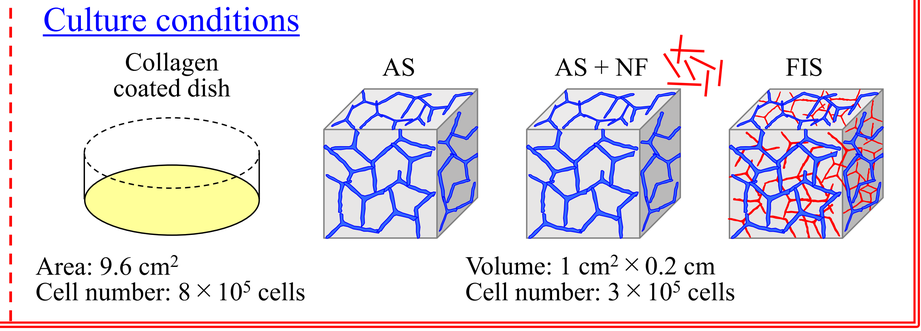
Achieving both cell-cell and cell-ECM adhesions!

Methods

Fabrication process of FIS



Culture conditions

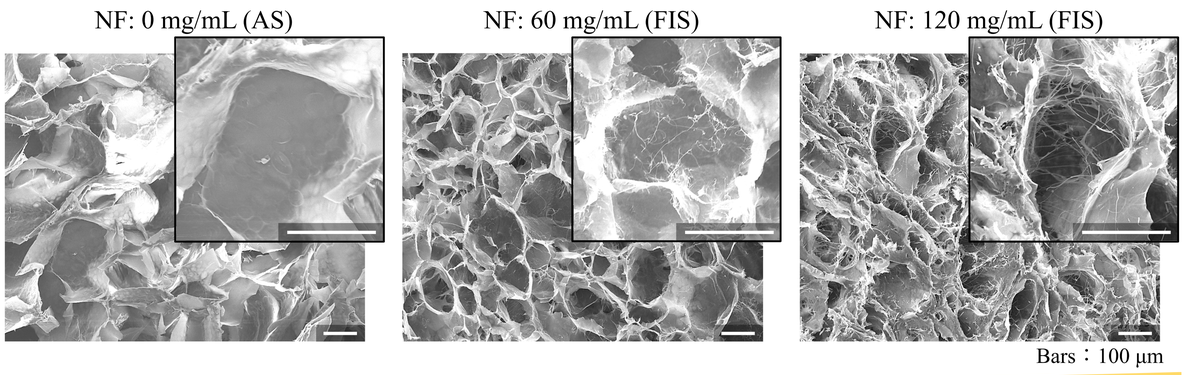


Area: 9.6 cm^2
Cell number: 8×10^5 cells

Volume: 1 $cm^2 \times 0.2$ cm
Cell number: 3×10^5 cells

Results

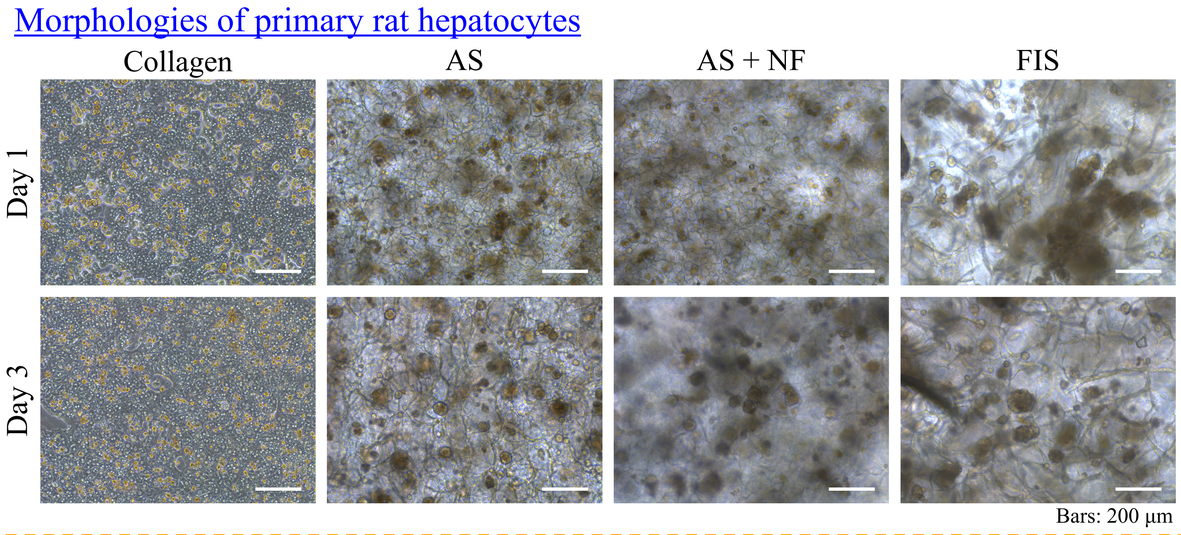
Structure of FIS



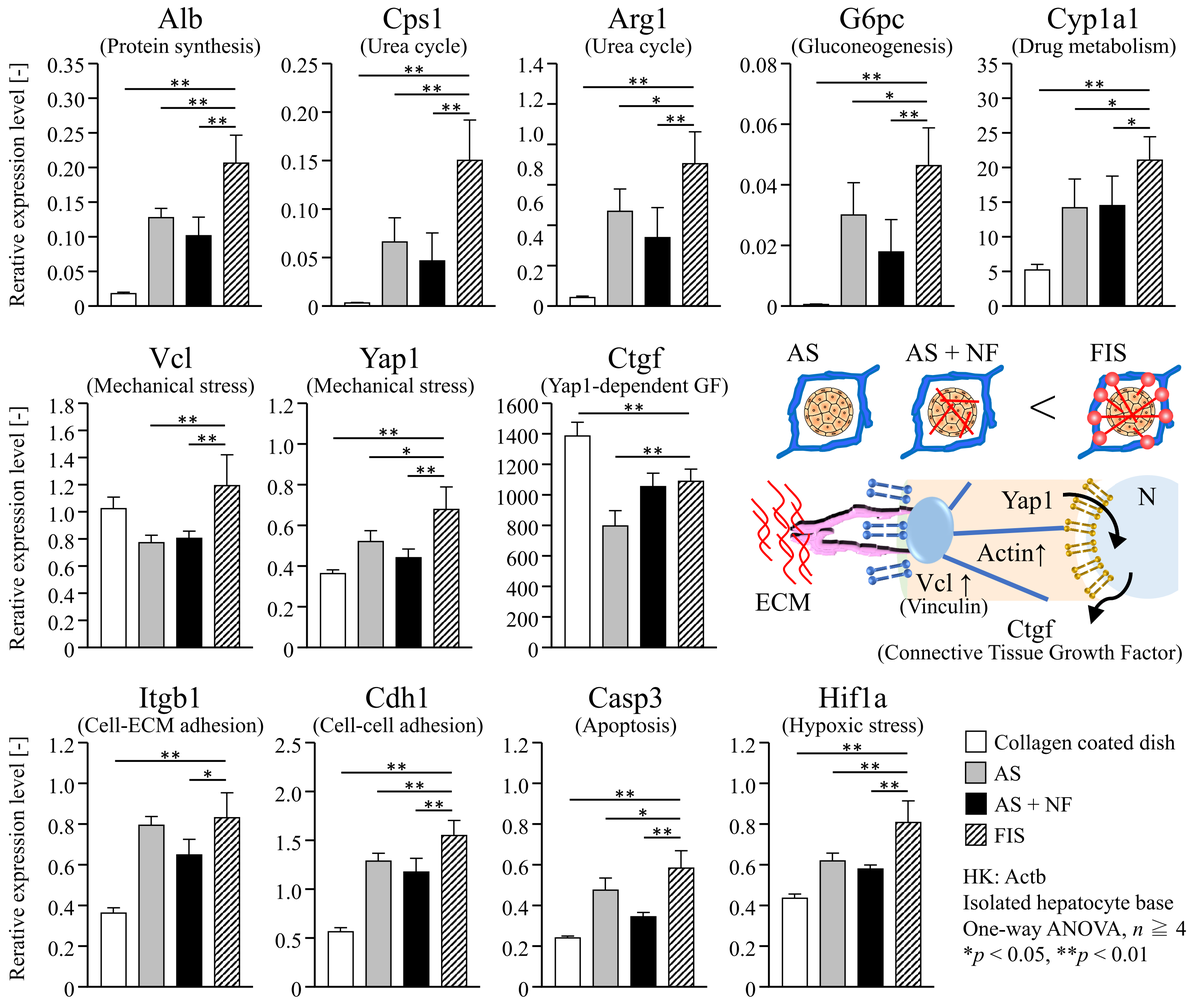
Number of NF bridges and the bridge formation rate: increased

Pore diameter: decreased

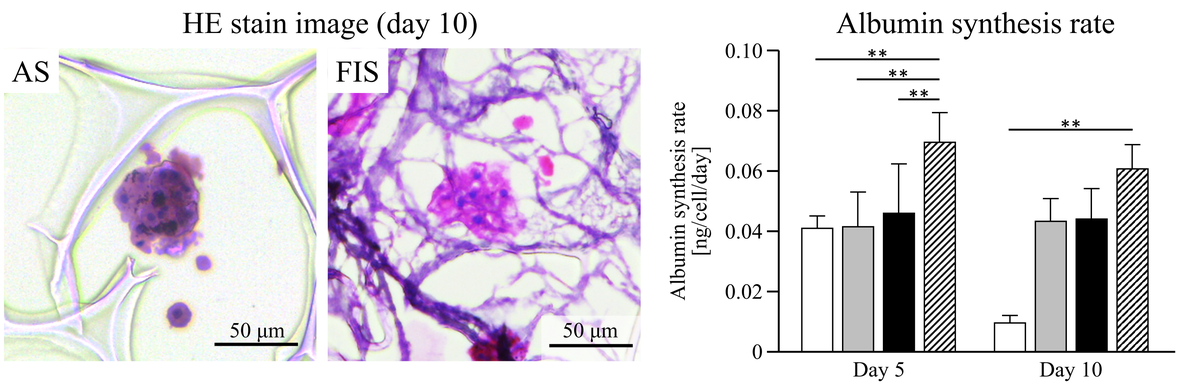
Morphologies of primary rat hepatocytes



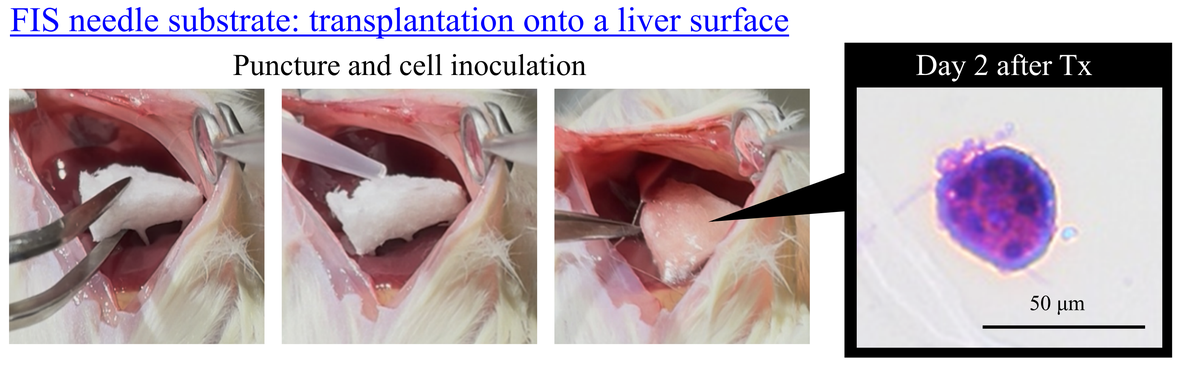
Gene expression (day 10)



Cell survival and protein expression



FIS needle substrate: transplantation onto a liver surface



In the future, we will clarify the behavior of cells in the FIS needle substrate and verify the therapeutic effects of cell transplantation on liver failure and diabetes model mice.

Conclusions

1. Fiber-immobilized sponge (FIS) was designed, consisting of a cell-non-adherent sponge scaffold and a cell-adherent Gel-NF.
2. Primary rat hepatocytes achieved tissue formation within the FIS and maintained liver-specific functions at high level.
3. Cell-ECM adhesion and mechanical stimulation in the early stages of culture may contribute to cell survival and high levels of functional expression.

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