Development of electrospun hollow fibres for muscle tissue engineering

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Introduction

Animal models present several limitations for drug testing applications:

- Human relevance
- Reproducibility
- Ethical concerns



Problem: There is an urgent need for commercially scalable human-relevant drug testing platforms for muscle tissue.

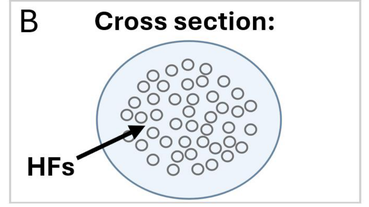
Aim: Produce a hollow fibre (HF) scaffold for later incorporation into HF modules. The scaffold shall be produced based on electrospinning, a method that has shown potential for mimicking the extracellular matrix of soft tissue.

Goals: The HFs should be producible at scale, promote enhanced gas and nutrient exchange, support muscle cell attachment and differentiation, and facilitate physiological mechanical stimulation of attached cells.

A



B **Cross section:**

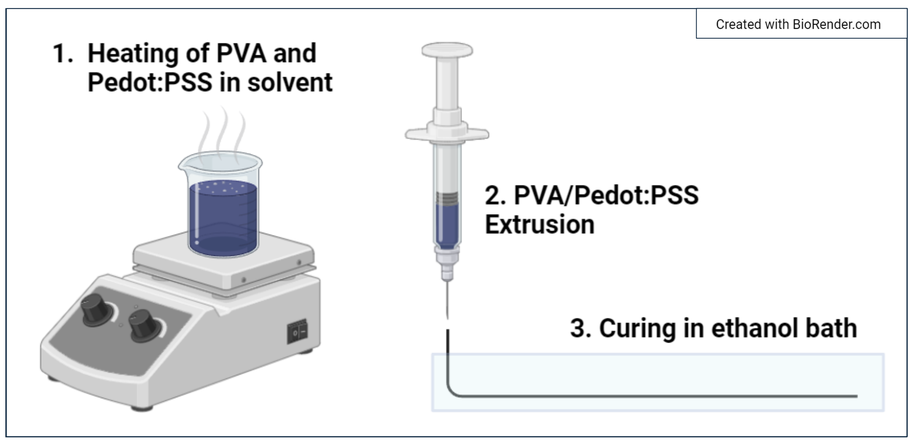


A: Hollow fibre (HF) module.

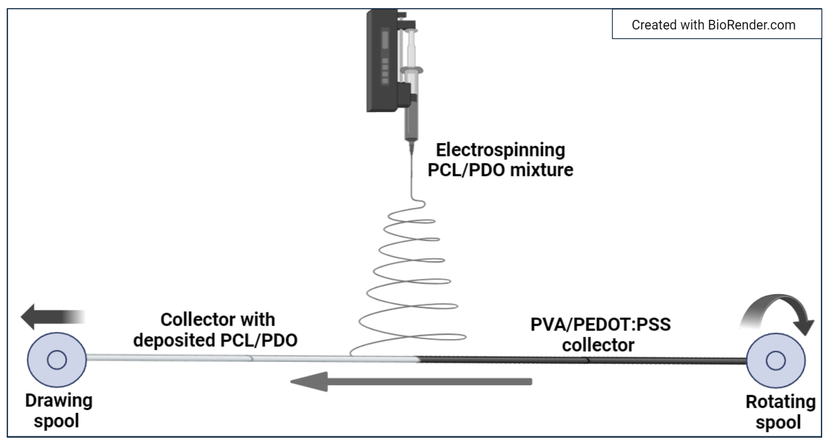
B: Cross section showing HFs.

Methods

1. Development of a dissolvable collector



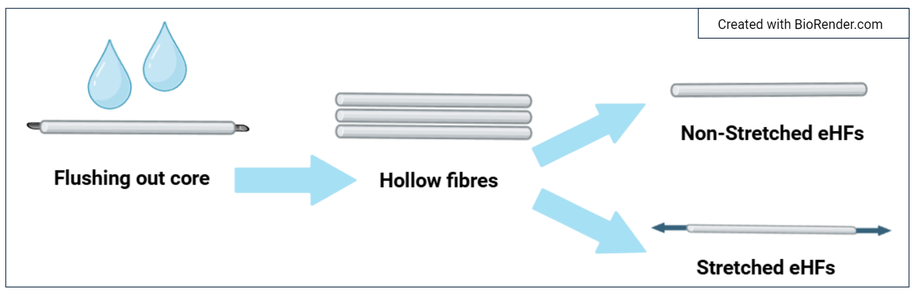
2. Production of electrospun hollow fibers (eHFs)



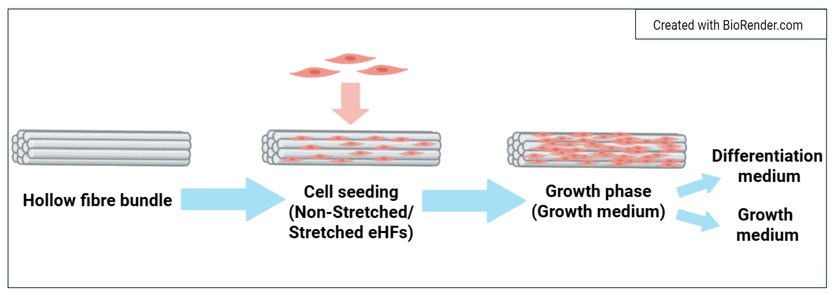
5. Analyses

1. Dissolvable collector properties
   - Electrical resistance
   - Extrusion length
2. Removal of dissolvable collector core from eHFs
3. Effects of fiber stretching
   - eHF dimensions
   - Microfiber diameter
   - Microfiber alignment
4. Muscle differentiation on eHFs
   - Non-Stretched eHFs: Growth or Differentiation medium
   - Stretched eHFs: Growth or Differentiation medium

3. Core removal and stretching of eHFs

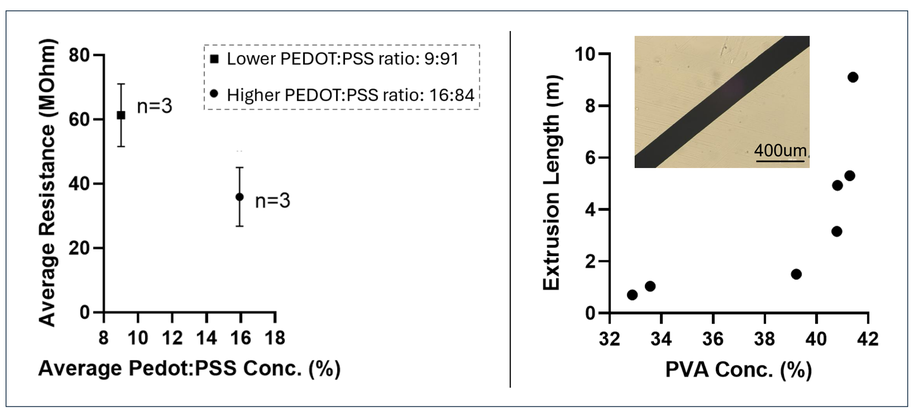


4. Dry seeding of immortalized human myoblasts

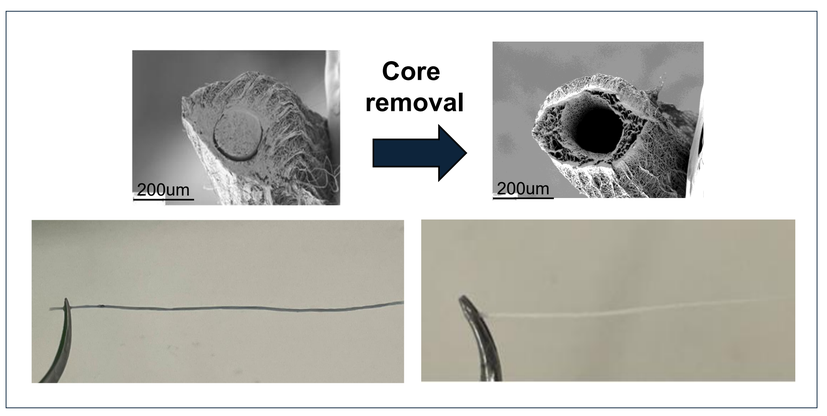


Results

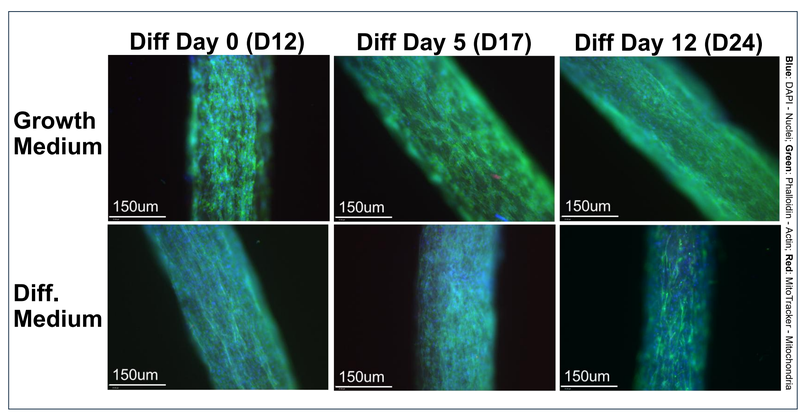
1. Dissolvable collector properties



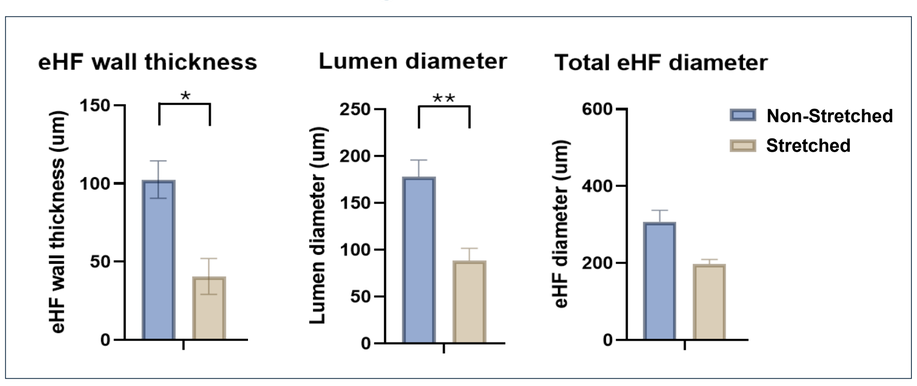
2. Removal of dissolvable collector core



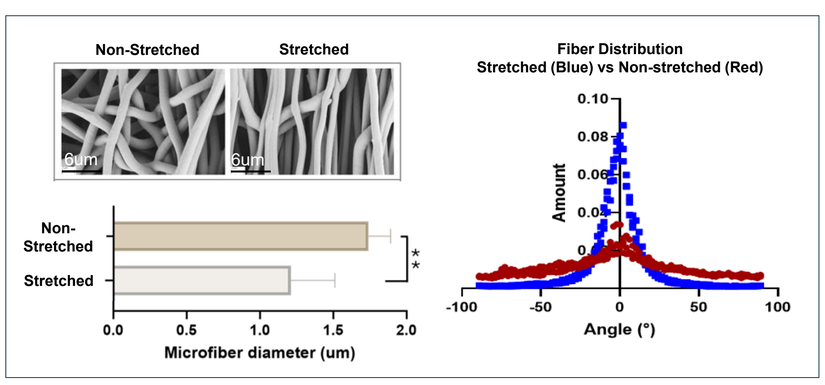
4.1 Muscle diff. on Non-Stretched eHFs



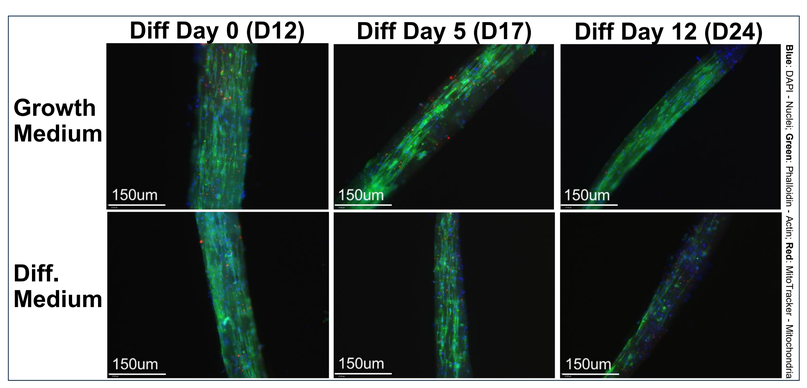
3.1 Effects of stretching on eHF dimensions



3.2 Effects of stretching on microfibers



4.2 Muscle diff. on Stretched eHFs



Conclusions

- A dissolvable collector with favorable electrical conductivity and extrusion length was successfully manufactured
- Electrospun hollow fibres (eHFs) with a diameter of 200-300µm and a lumen of ~85-175µm were produced using the collector
- Stretch-induced alignment of microfibres was confirmed
- Cells were cultured on (non-)stretched eHFs in growth or differentiation medium

Future work

- Additional analysis of muscle cell differentiation on non-stretched and stretched eHFs using differentiation markers
- Integration of eHFs into a bioreactor module
- Mechanical stimulation of cultured human myoblasts
- Validation of the platform's reliability for drug testing applications

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