

# Electrospinning Natural Polymers for Tissue Engineering Applications

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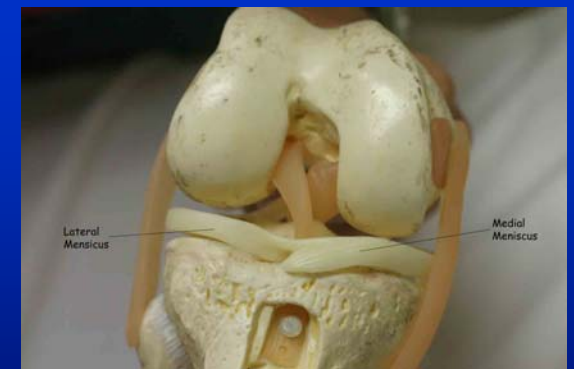
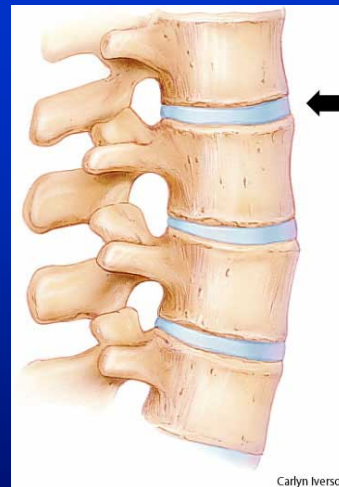
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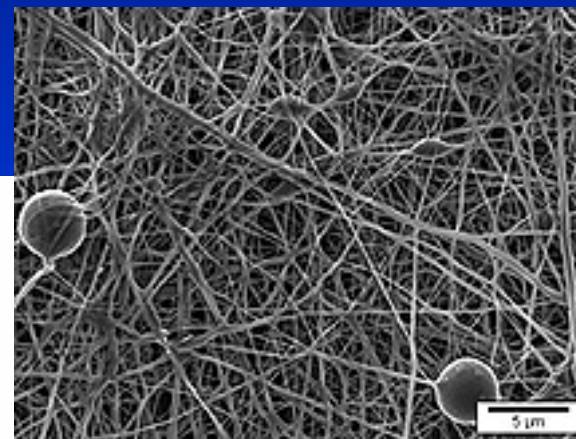
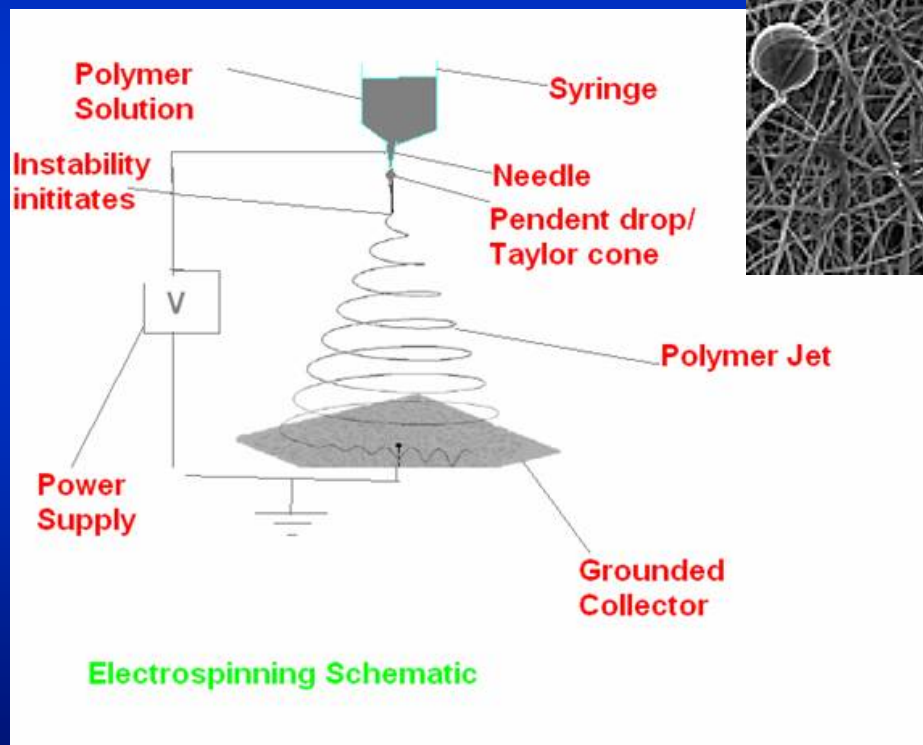
# Tissue Engineering

- **Problem:** Organ/tissue shortage
- **Solution:** Biologically functional structures to...
  - Deliver cells
  - Support 3D tissue formation
  - Other applications
- Challenges



# Electrospinning

- Produces structures composed of nanofibers
- Variety of polymers used
- Schematic:



<http://chemistry.mtu.edu>

<http://web.mit.edu>

# Fibrinogen & Collagen

- Candidate materials for electrospun scaffolds
- **Potential advantages:**
  - *Fibrinogen* : Wound-healing capability
  - *Collagen* : Major structural component of the ECM
  - Naturally occurring proteins
- Electrospun fibrinogen is a novel structure (McManus 2005)

# Summer Goal

- Optimize the conditions for electrospinning natural proteins
  - Concentration of solution
  - Voltage
  - Working distance
  - Flow rate
- Hypothesis:

Natural polymers can be electrospun into nanofibrous structures that can support cell growth.

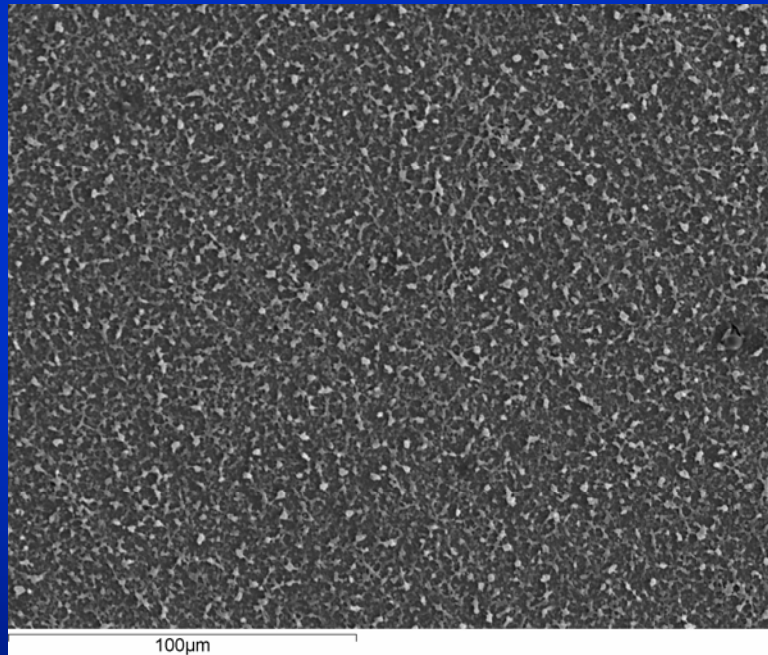
# Method

- Control parameters:
  - 71 mg/mL fibrinogen in MEM
  - 22 kV
  - 10.0 cm working distance
  - 2.0 mL/hr flow rate

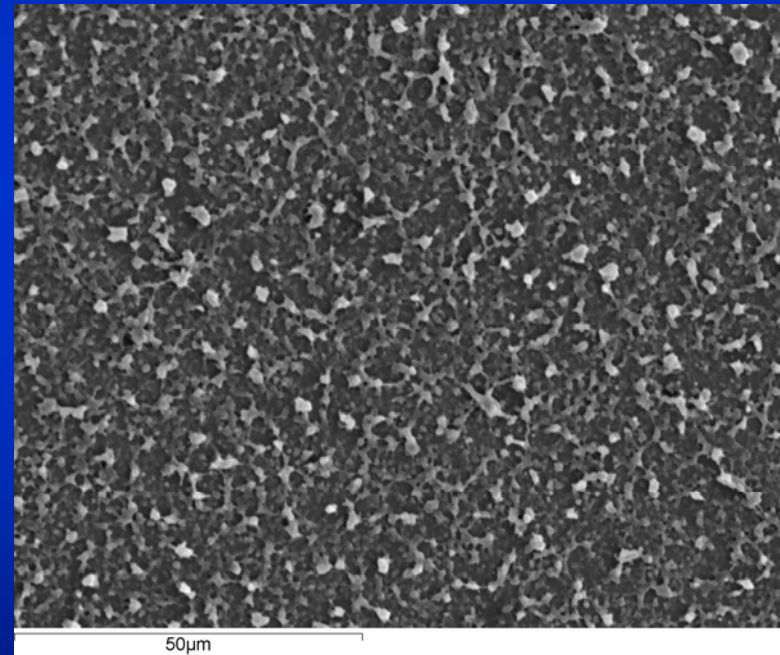


# Preliminary Results & Challenges

- No fibers formed; uniform beads ( $\sim 1 \mu\text{m}$ )
- Difficulty of dissolving fibrinogen



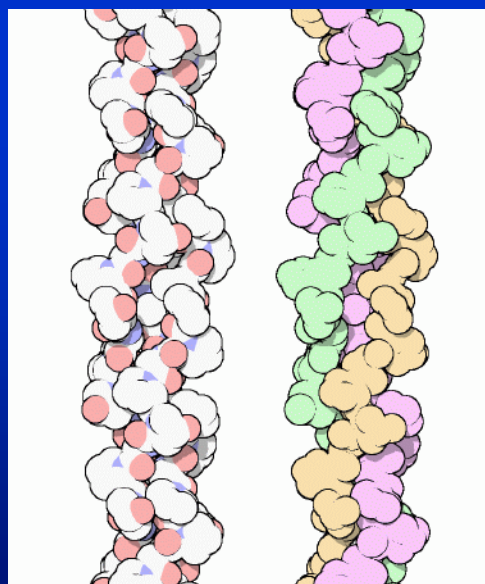
500X



1000X

# Collagen: Another Natural Polymer

- Major structural component of the ECM
- More commonly electrospun than fibrinogen
- May allow a greater understanding of how to form a nanofibrous fibrinogen structure

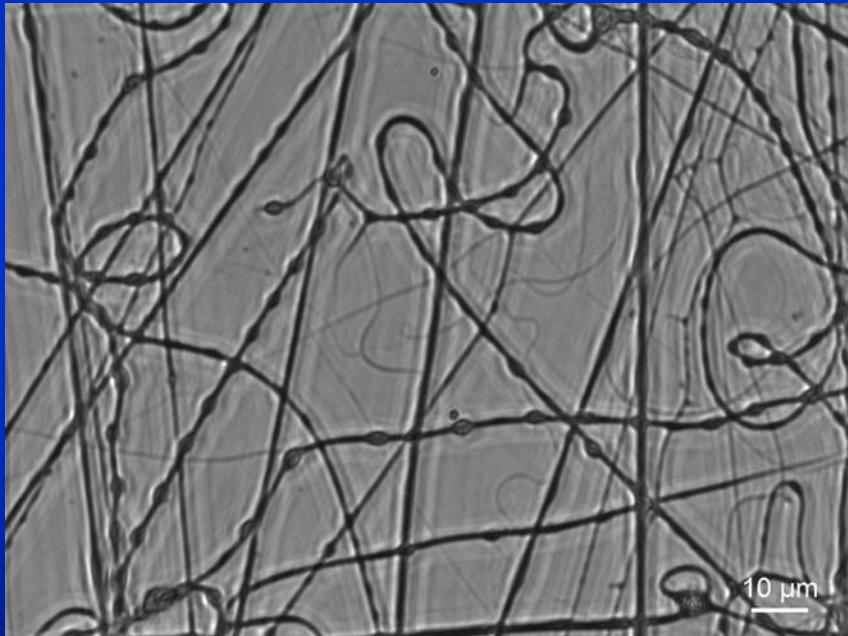


<http://www.pdb.org>

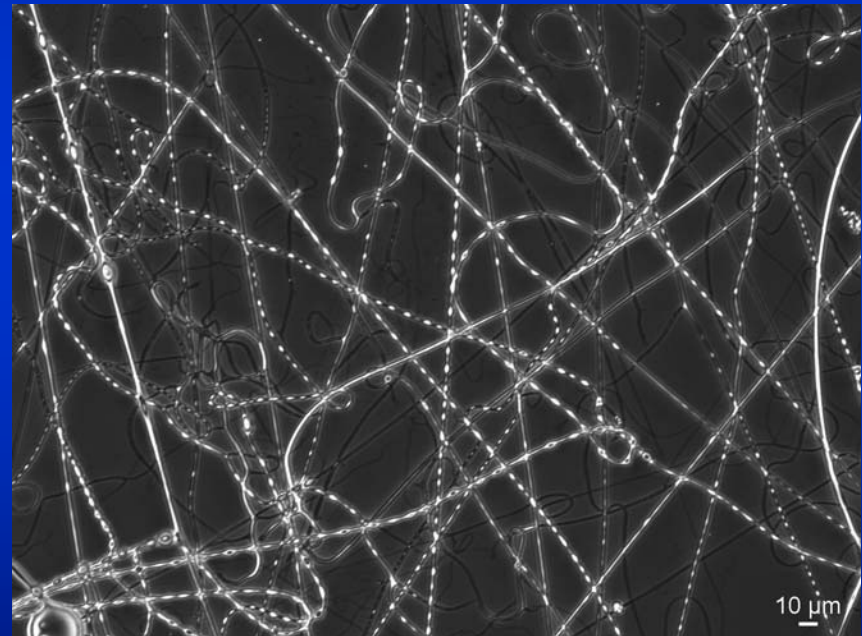


# Results - Collagen

- Nanofibers formed from electrospinning collagen
- Some non-uniformities observed



60X

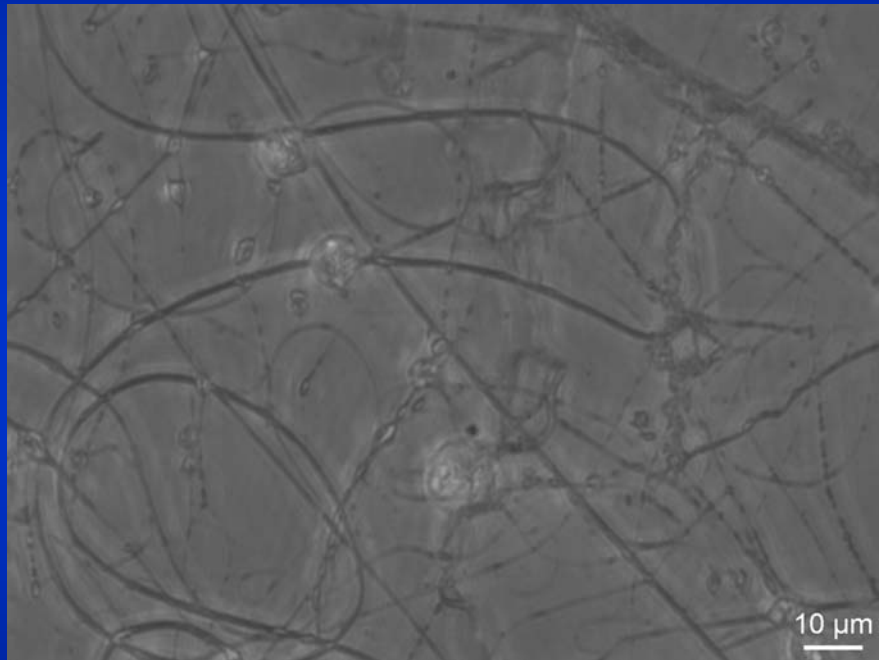


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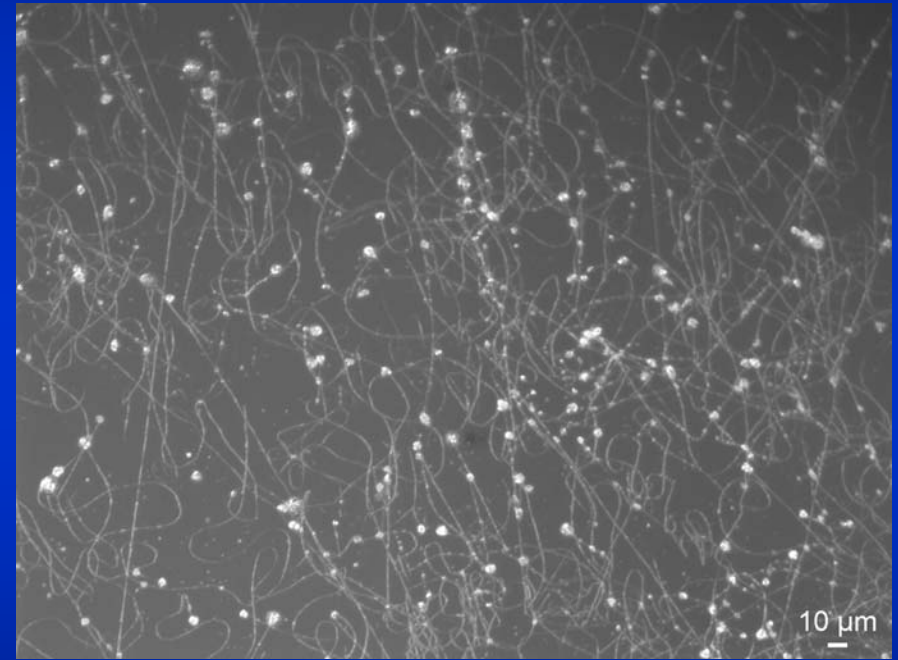
# Observations

- Collagen solution was more viscous than fibrinogen solution
- Did not require the presence of salts to form fibers
- Using this information, fibrinogen electrospinning parameters were modified:
  - 9X smaller proportion of solvent added
  - 98 mg/mL fibrinogen in ddH<sub>2</sub>O

# Results - Fibrinogen



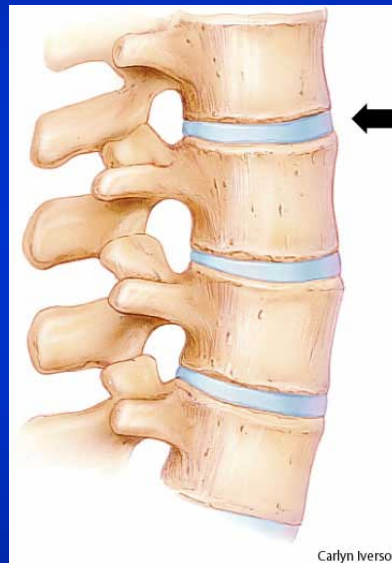
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# Future Work

- Achieve the formation of more uniform nanofibers
- Seed fibrinogen/collagen scaffolds with cells of the IVD



- Evaluate the potential of natural polymers as a TE construct

# Questions?

Special thanks to...

