UNIVERSITÀ DI PISA

Massachusetts Institute of Technology

MIT-UniPI Project – Seed Funds

Design of Multifunctionalized Scaffolds Mimicking Native Cardiac Tissue

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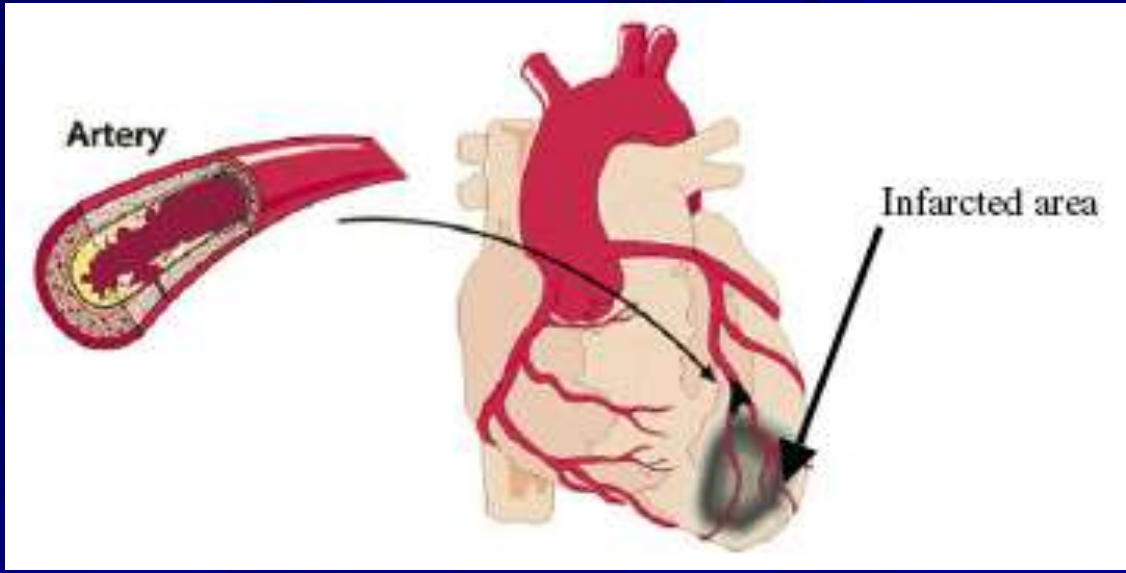
Introduction



Current treatments:

- left ventricular assist device → infection
- cardiac transplantation → rejection, lack of organ donors

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Cell-based therapy

I. Cellular cardiomyoplasty → low cell engraftment
II. Tissue engineering strategies

Aim of the project

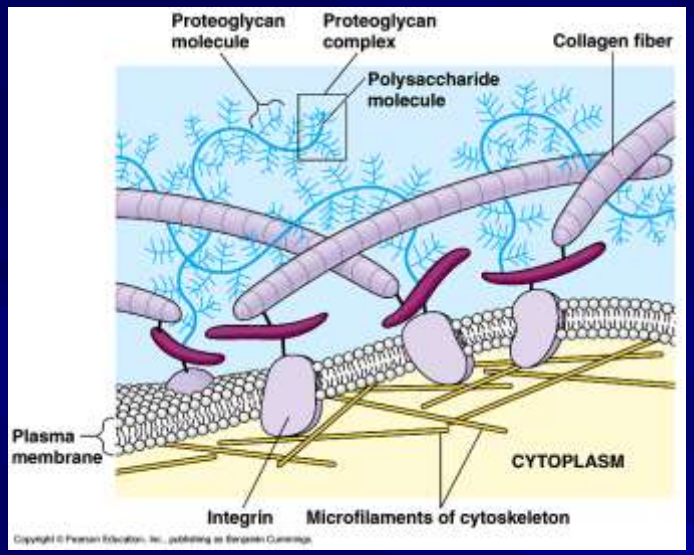
Design of multifunctionalized scaffolds for myocardial tissue engineering that will take inspiration from nature at different levels:

1. *Choice of the materials for porous scaffold fabrication:* blends of natural polymers mimicking the composition of native cardiac ECM;

2. *Fabrication design:* inclusion of synthetic polymeric microfibers, mimicking ECM architecture and improving mechanical properties;

3. *Development of a bioactive microenvironment:* biochemical signals loaded in the scaffold by advanced functionalization techniques.

Blends of natural polymers mimicking cardiac extracellular matrix

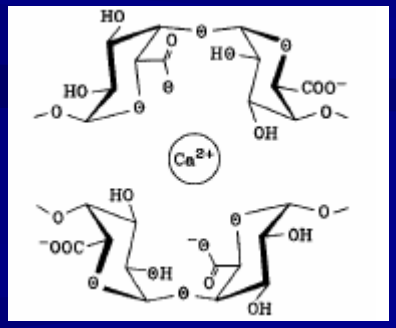


Extracellular matrix (ECM)

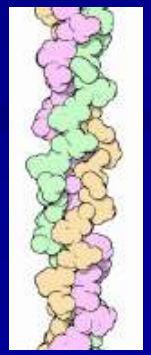
Structural support for tissues

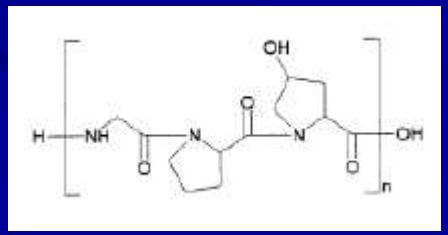
Cellular recruitment, adhesion, proliferation and differentiation

Alginate



Collagen, Gelatin



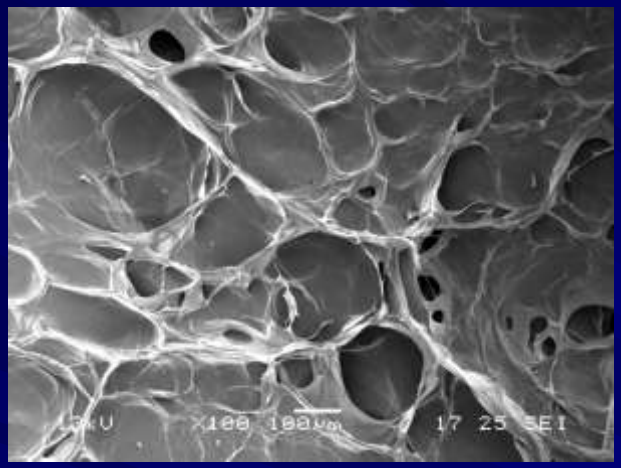


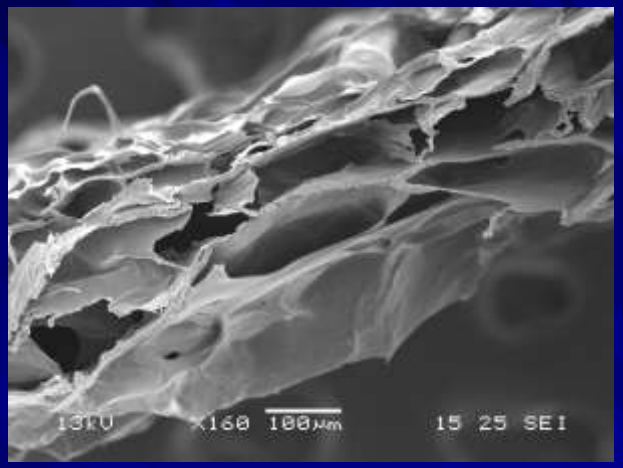
Scaffold characterization

	Alginate/Gelatin	Alginate/Collagen	Decellularized myocardial tissue
Morphological analysis	□	□	x
Infrared analysis	□	□	x
Thermal analysis	□	□	x
Swelling test	□	□	x
Degradation test	□	□	n.a.
Permeability test	□	□	x
Mechanical characterization	□	□	x
Cell culture test in static conditions	□	□	n.a.

Alginate/Gelatin scaffold selected for further studies

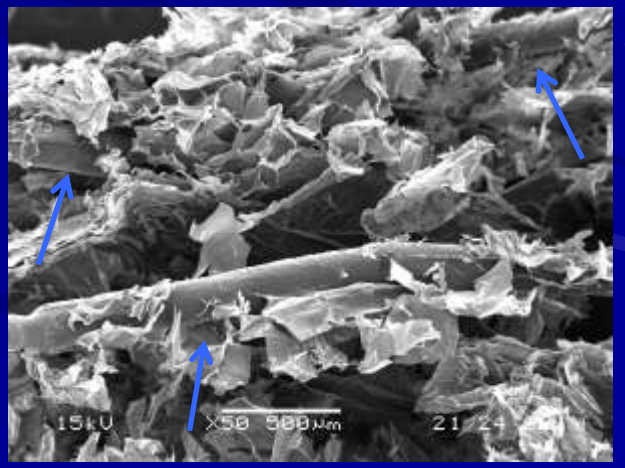
Scaffold fabrication





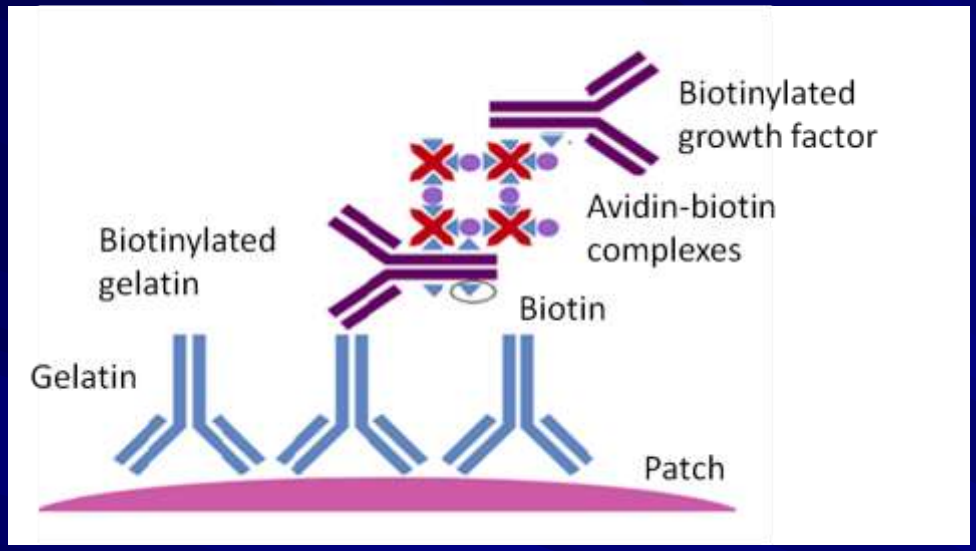
Alginate/gelatin scaffold obtained by freeze-drying

- Improved suturability
- Mimicking fibrous architecture of cardiac ECM



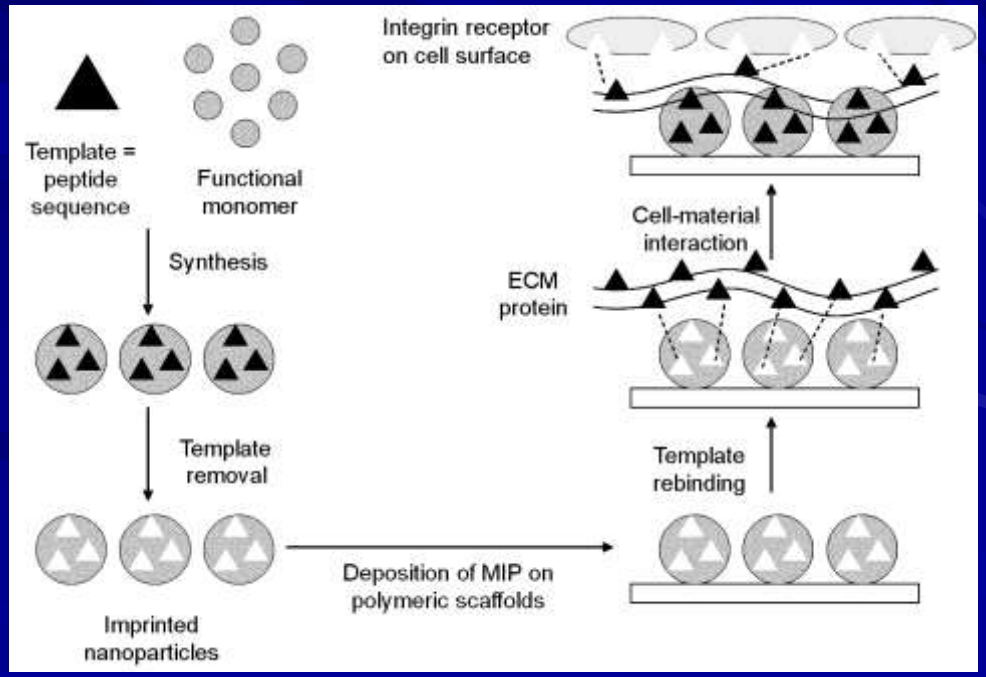
Inclusion of synthetic microfibers

Scaffold functionalization

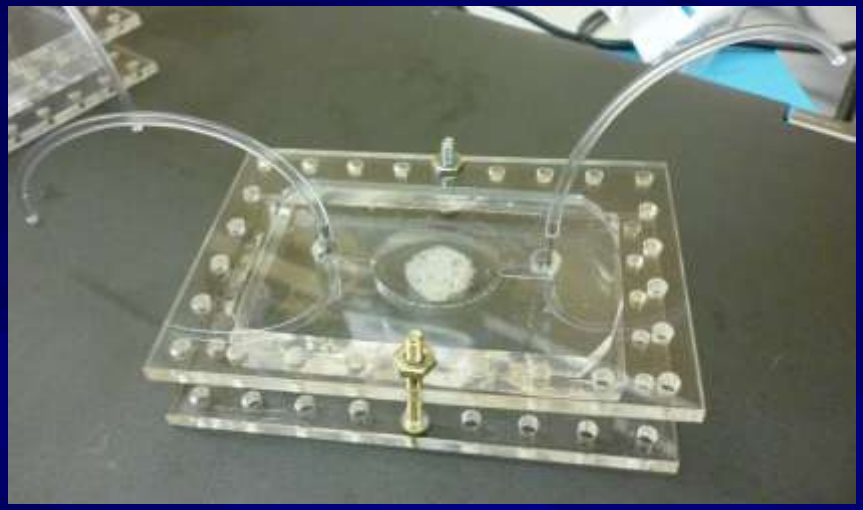


Functionalization using the avidin-biotin binding system

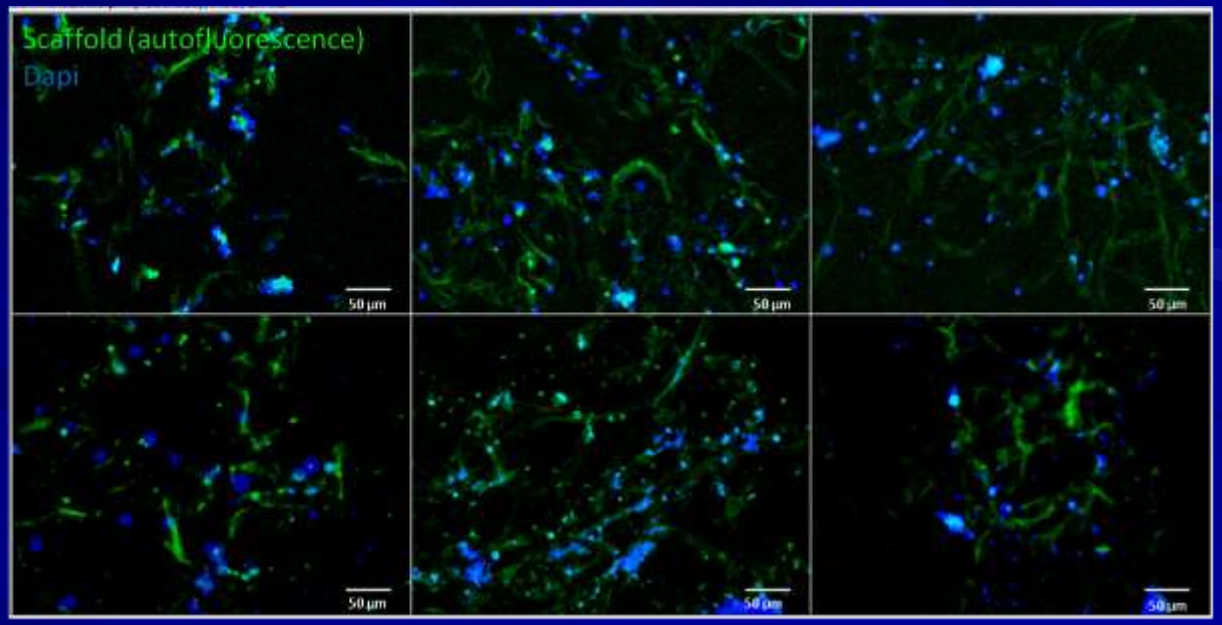
Scaffold functionalization using molecularly imprinted polymers (MIP)



Cell culture tests in the microfluidic bioreactor

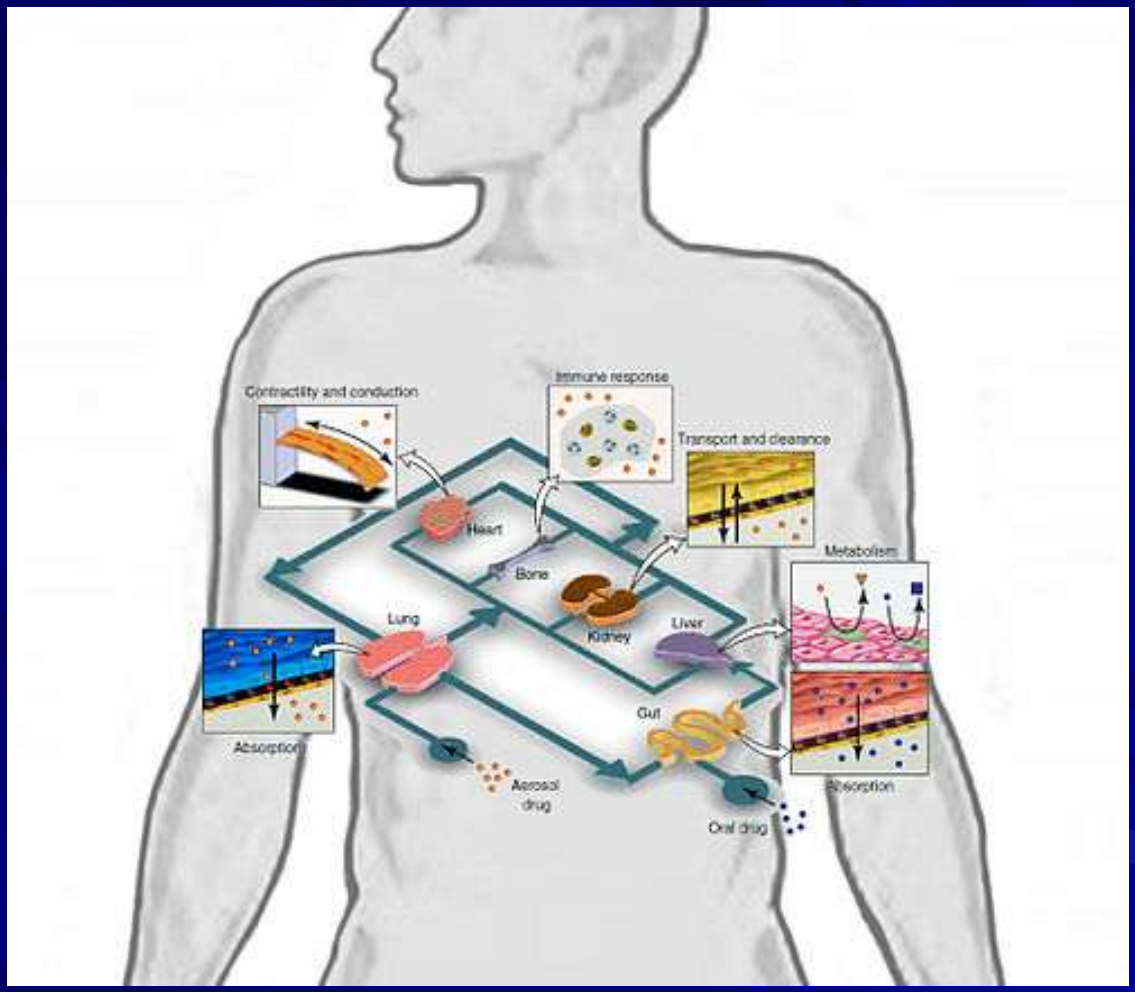


Currently ongoing @ MIT



Day 7

Future developments



Integration of fully biomimetic cardiac scaffolds into "human-on-a-chip" platform

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