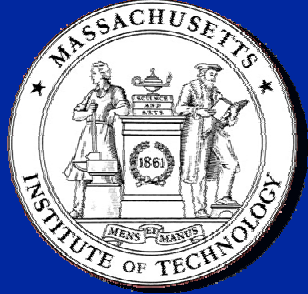
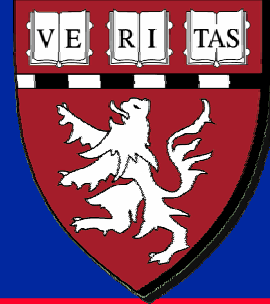


Harvard-MIT Division of Health Sciences and Technology
HST.535: Principles and Practice of Tissue Engineering
Instructors: Myron Spector



Massachusetts Institute of Technology
Harvard Medical School
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HST 535

DISCUSSION:
Comparative Analysis of Tissue Engineering
Strategies

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TISSUE CHARACTERISTICS AND APPROACHES

Tissue	Lec.	Hollow (Tube) v. Solid	Layered Y or N	Immed. Funct. Y or N	Blood Contact Y or N	Cell Type	Scaff.
Periph Nerve	Yannas Gong	S	N	N	N	Nerve	Collag. Chitin
Blood Vessel	Schoen	H	Y	Y	Y	Ep, CT, Muscle	Collag. PGA
Heart Valve	Li	S	Y	Y	Y	Ep, CT, Muscle	PGA
Urin.	Atala	H	Y	Y	N	Ep, CT, Muscle	SIS Others
Bone	Liu/Xu	S	N	N	N	CT,stem	Coll/HA
Cart.	Liu/Spec	S	N	N	N	CT	Collag.

EXAMPLE OF A HOLLOW, LAYERED STRUCTURE

Epithelial cells

Muscle cells

Connective tissue cells

Diagrams removed for copyright reasons.
Coronary artery structure: from Netter, F. H.
Heart (Ciba Collection), 1969.

HOLLOW (TUBES) VERSUS SOLID ORGANS

Hollow (Tubes)

- **Vessels that carry blood or urine**
- **Layered structures:**
 - **Epithelium**
 - **Smooth muscle cells**
 - **Connective tissue**
- **Immediate function**

LAYERED STRUCTURES*

How to engineer a layered structure?

- Separately seed layers of a scaffold with different types of cells
- If all the cell types are mixed and added to a scaffold will they segregate eventually to form separate layers?

*Some connective tissues like bone have a lamellar architecture, but these are layers of the same bone materials (*i.e.*, same cell type in each lamella or layer)

IMMEDIATE FUNCTION

- The degree to which the implant needs to support immediate function dictates the degree to which the tissue engineered construct needs to be mature before implantation.
- Properties cannot degrade with time.

Vessels

- Can the tissue engineered vessel be isolated from flow for a certain time period after implantation?

Musculoskeletal Tissues (*e.g.*, bone and cartilage)

- Can the tissue/joint be immobilized (unloaded) post-operatively (using metal rods and plates)?

OTHER NEW CONCEPTS

Scaffolds: Biological Materials Processed to be Implants

Tissue processed to eliminate the cells and retain some of the extracellular matrix composition and properties.*

- **Coral (selected for its porous architecture)**
 - CaCO_3 and also coral converted to hydroxyapatite but with retained coral architecture
- **Demineralized bone matrix (DBM)**
- **SIS (small intestine submucosa)**
 - Porcine connective tissue

* Biomimetics (Cui); ECM analogs (Yannas); biomat. should mimic ECM of tissue to be engineered (Atala)

OTHER NEW CONCEPTS

Culture Medium

- Use of human autologous serum for growing cells *in vitro*