

Tissue Fragment Injection System

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+ Points of Interest

- Client Information
- Problem Statement
- Background: Vx-2
- Current Methods: Surgical & Percutaneous
- Design Criteria
- Design Alternatives
- Design Matrix
- Final Design
- Future Work
- Conclusions
- Questions



+ Client Information



- Dr. Chris Brace
- UW-Madison, Department of Radiology and Biomedical Engineering

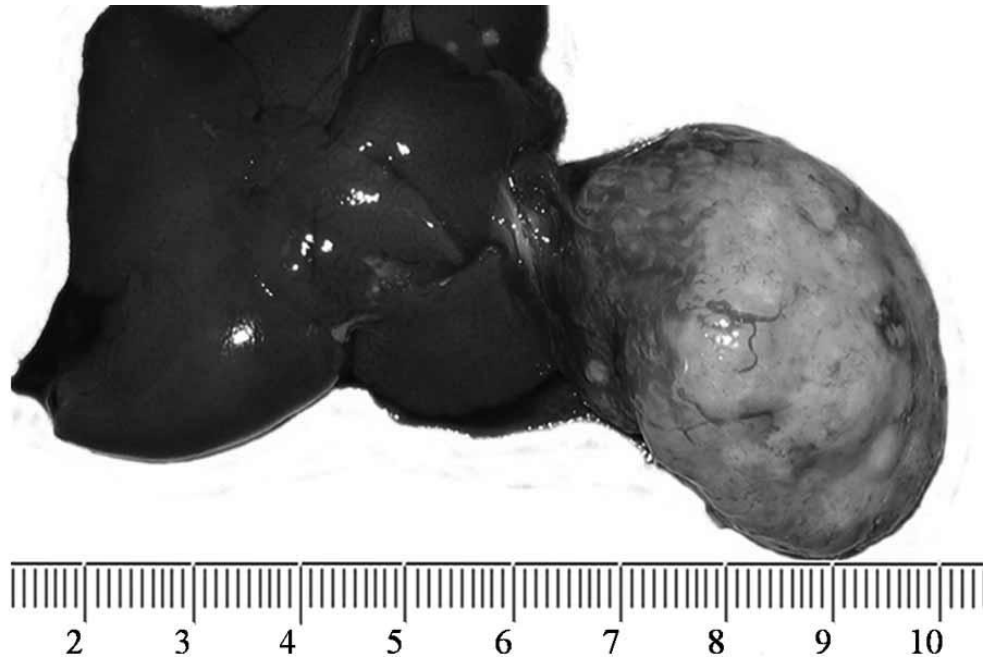
+ Problem Statement



- Injection of Vx-2 carcinoma tumor cells in rabbit livers
- Percutaneous less invasive than surgical
- Limitations
 - Suturing
 - Unwanted seeding
 - Backflow
- Eliminate limitations and lower technical skill required

+ Vx-2 Carcinoma Tumor Model

- Liver is most common site for metastases
- Used in rabbits to study liver cancer growth and develop treatments
- Similar characteristics to human liver tumors



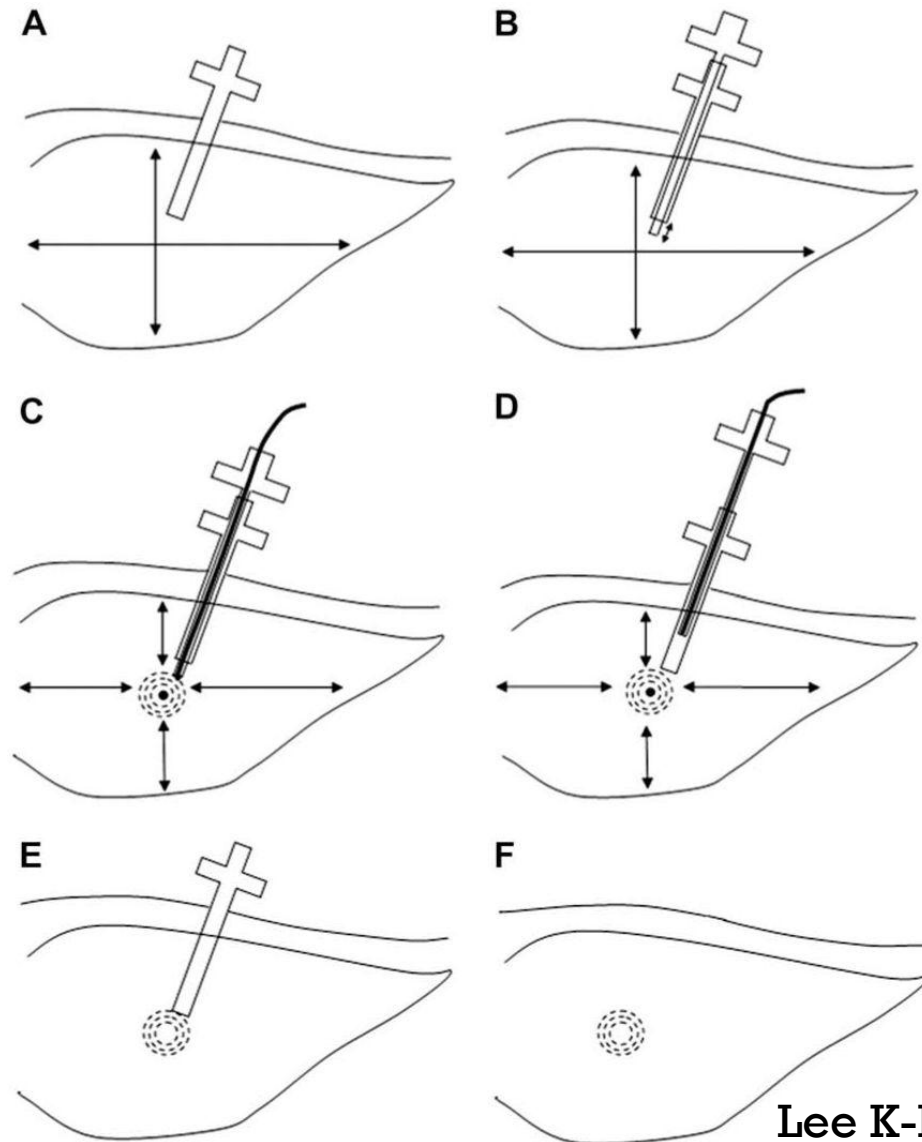
+ Surgical Method

- Most common implantation method
- Advantages
 - Easy access to implantation site
 - Accurate cell placement
 - Minimal unwanted seeding in abdominal cavity
- Limitations include
 - Long recovery time
 - Anesthetic complications
 - Length of procedure
- Dr. Brace's current protocol is surgical



+ Existing Percutaneous Method

- 16-gauge needle with a 14-gauge sheath
- Wire used to push out tumor cells
- Guided by ultra sound imaging



+ Design Criteria

- Seed tumor cells to the liver
- Prevent unwanted tumor cell seeding
- Decrease procedure time
- Decrease technical skill
- Biocompatible materials
- 18-gauge needle
- 5 cm insertion depth
- Ergonomics

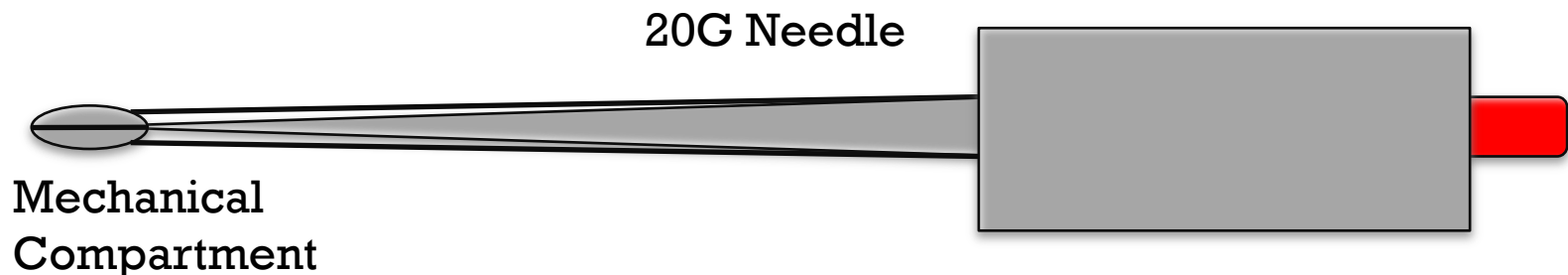




Design Alternatives: Cellular Delivery Mechanism (CDM)

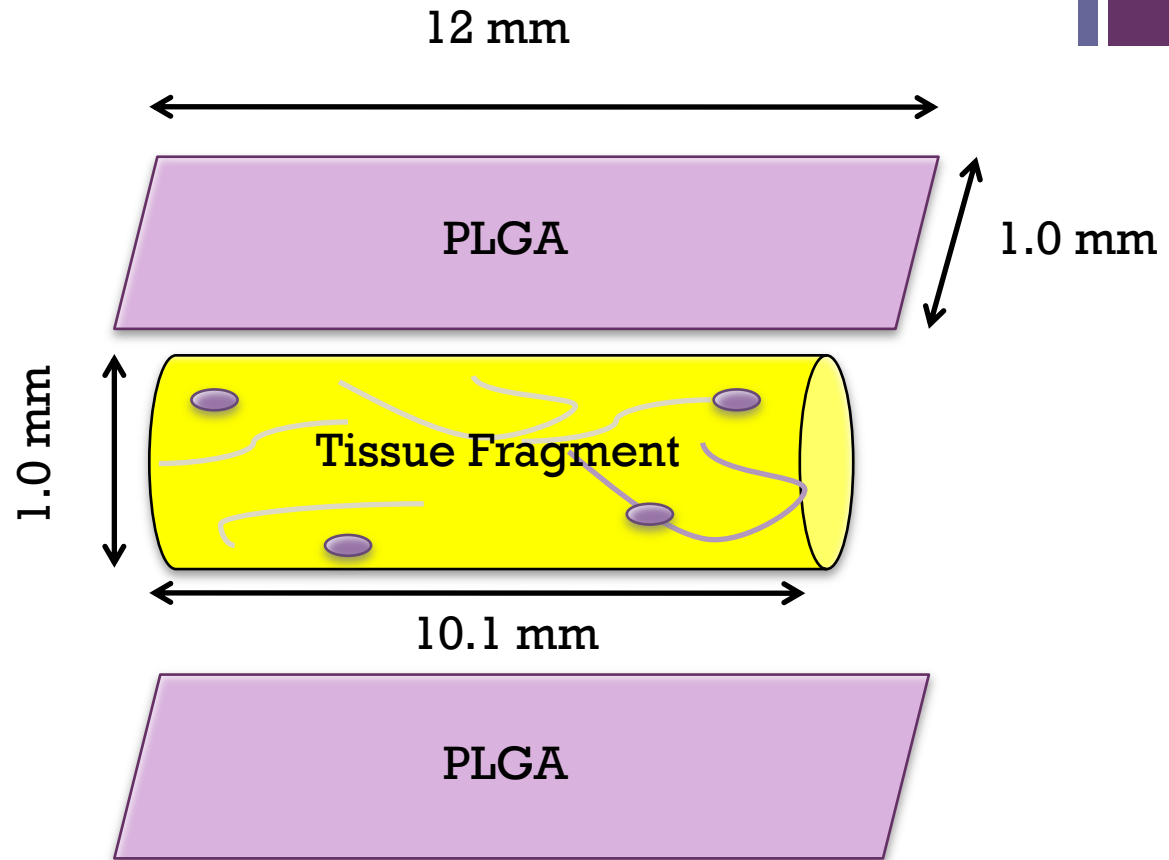


- Mechanical release
- Uses two coaxial needles
 - 20-gauge and 18-gauge
- The 20-gauge has a specialized end
- Cells directly loaded into compartment



+ Design Alternatives: PLGA Capsule

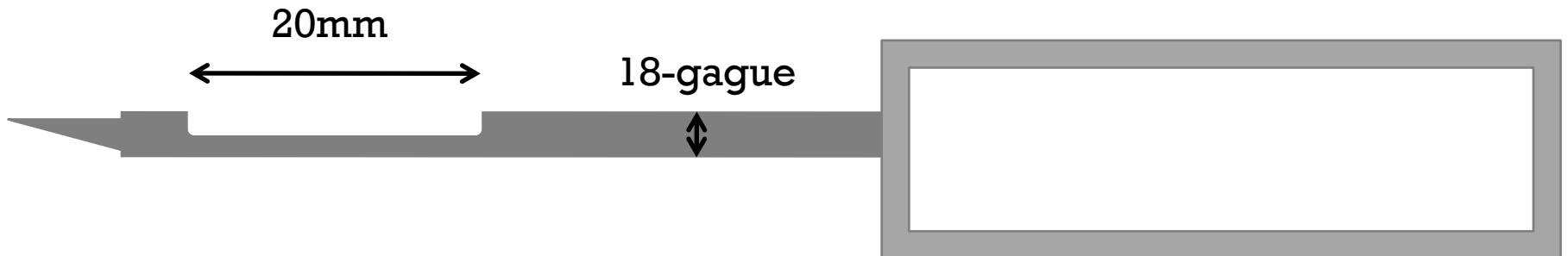
- Polylactic-co-glycolic acid
- Biodegradable
- Biocompatible
- Mechanical flexibility
- Dye-casting



+ PLGA Capsule Cont.



- Biopsy needle
- Tissue fragment notch
- Retractable sheath

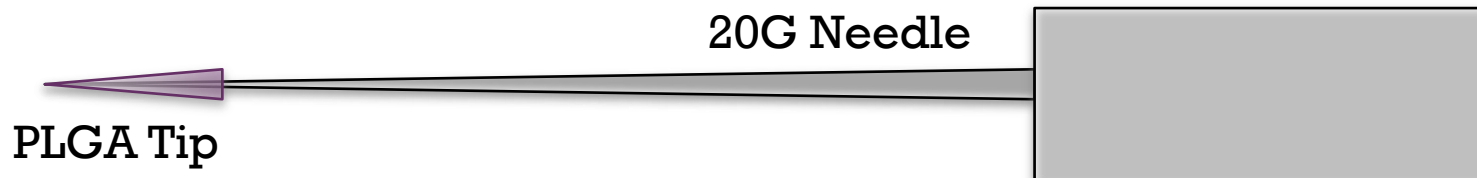




Design Alternatives: PLGA Covering with N-IPAAm Plug



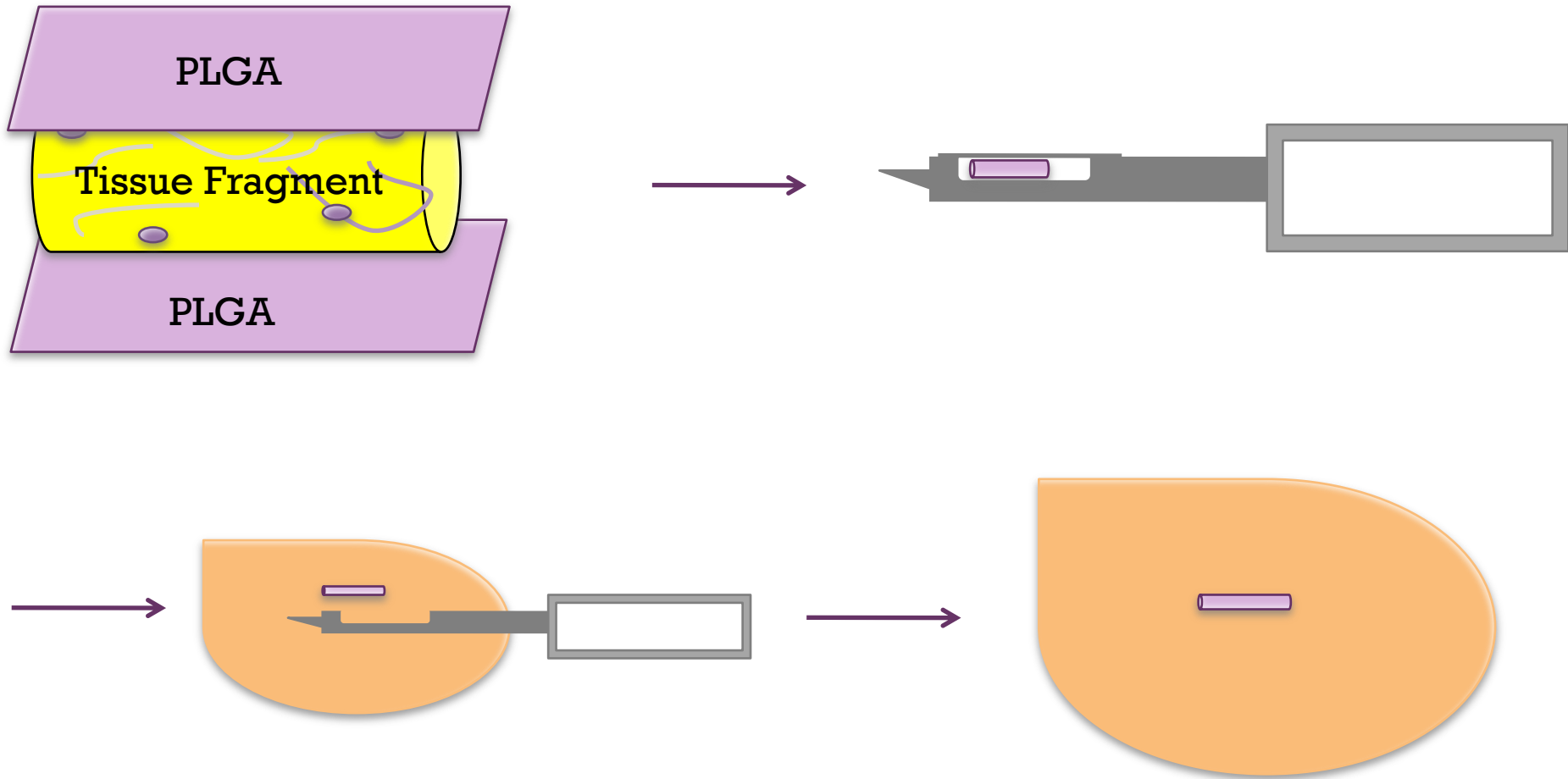
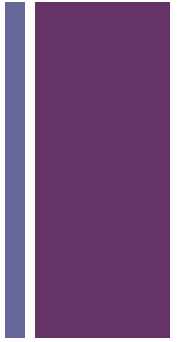
- 3 Needles
 - 18-gauge guide needle
 - Two 20-gauge needles
 - 1st: PLGA needle tip & cells
 - 2nd: N-IPAAm
- Uses cell suspension



+ Design Matrix

Criteria	Weight Value	PLGA Capsule	PLGA covering and N-IPAAm Plug	CMD
Cost	10	6	5	7
Ease of use	20	15	12	12
Bio compatibility	20	10	8	15
Ergonomics	10	7	7	7
Reliability	30	18	22	6
Ease of production	10	8	6	4
Total	100	64	60	51

+ Final Design: PLGA Capsule



+ Future Work

- Testing with PLGA
- Testing with biopsy needle
- Method of PLGA encapsulation
 - “Sandwich” between two sheets
 - Encapsulate in pellet form
- RARC Certification



+ Conclusions

- Decreased technical skill required
- Procedure time reduced
- Minimal unwanted seeding
- Minimal backflow of cells



+ Acknowledgements



- Dr. Chris Brace - Client
- Dr. Randolph Ashton - Advisor



References



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- Luo et al. Role of sonography for implantation and sequential evaluation of a VX2 rabbit liver tumor model. *J Ultrasound Med* 2010; 29:51–60.

