CHRD 2021: Abstract & Poster Submission Form

Submitter Name

Philip
First

Imasuen
Last

Email

imasuenp@myumanitoba.ca

Research Category:

- ◉ Basic Science
- ○ Clinical
- ○ Community Health / Policy

What was your role in the project?

- ☑ Design
- ☑ Perform Experiments
- ☑ Analyze Data
- ☑ Write Abstract
- ☐

Presenter Status:

- ◉ Undergraduate Students
- ○ Masters Student
- ○ PhD Student
- ○ Post-Doctoral Fellows
- ○ Residents
- ○ Non-Trainee

Title

Testing Manufacturing Strategies to Improve the Structure of Three-Dimensional (3D) Bioprinted Muscle

Background

Three-dimensional (3D) muscle cultures can circumvent limitations of 2D cell culture by better simulating how cells behave in the human body. However, engineering a structure that withstands muscle contractile force is challenging.

Objective

Using novel 3D bioprinting technology, we aimed to create an easy-to-produce 3D muscle tissue that can withstand contractile forces better than current methodology.

Methods

Smooth muscle cells were bioprinted at 2.5×10^7 cells/mL in an alginate-collagen-fibrinogen bioink. The muscle was encapsulated within a spiderweb-like acellular structure (0.75-1.25% alginate). Then, a solid holder was designed to engage with holes in the spiderweb and oppose contractile force. Tissues were created by two methods: 1) ‘Slide’. Tissues were bioprinted onto a nylon membrane, the holder placed over the spiderweb, then the tissue/holder slid sideways off the membrane; 2) ‘In-Transwell’. Tissues were bioprinted into a Transwell, then a tissue holder was lowered over it. Methods were compared on processing ease, long-term structural integrity, and ability to image and document contractions.

Results

Bioprinting onto membranes required 20-30% higher material pressure and 5-10% slower print speeds than bioprinting into Transwells, and membrane tissues had higher occurrences of low fidelity prints. ‘Slide’ was prone to human error, with a success rate of approximately 50%, and muscle produced by this method tended to break down after one week. ‘In-Transwell’ bioprinting had success rates >90%, and imaging/contraction studies operated smoothly. The structure of ‘in-Transwell’ tissues held up well during extended culturing, even with highly contractile tissues.

Conclusion

‘In-Transwell’ was the superior methodology, demonstrating improved printing parameters, higher tissue fidelity, higher success rate, and longer culture life than ‘slide’ tissues. Moreover, ‘in-Transwell’ tissues were suitable for live-cell imaging and contraction assays, and will be used for ongoing disease and treatment studies. Further improvements will allow ‘in-Transwell’ tissues to also be used for skeletal and cardiac muscles that require significantly different contraction protocols.

Authors

- For each author, please click "**[+] Add Item**" and provide the author's information

Name	Email	Role	Profession
Philip Imasuen	imasuenp@myumanitoba.ca	Presenting Author	Undergrad Student
Ahsen Haroon	haroona1@myumanitoba.ca	Co Author	Undergrad Student
Lumiere Parrenas	parrenal@myumanitoba.ca	Co Author	Undergrad Student
Emily Turner-Brannen	ETurner-Brannen@chrim.ca	Co Author	Technician
Adrian West	Adrian.West@umanitoba.ca	Co Author	Assistant Professor