# Manufacturing Strategies For Improving The Structure of 3D Bio-printed Muscle

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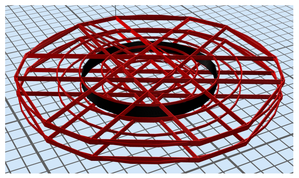
## INTRODUCTION

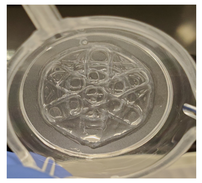
Dr. West's research recognizes that 2D muscle cell cultures due to being flat and in a stiff plastic environment do not effectively represent the contractile nature of muscle cells in a 3D environment. So, the solution to this is using 3D bioprinting technology and making 3D muscle cell cultures. But consideration must be made for a structure and methodology that supports a structure that will hold up.

## AIM

Testing relative success of two methods of getting next generation spiderweb design for 3D muscle cell cultures onto polycarbonate plastic holder.



Spiderweb design computer model



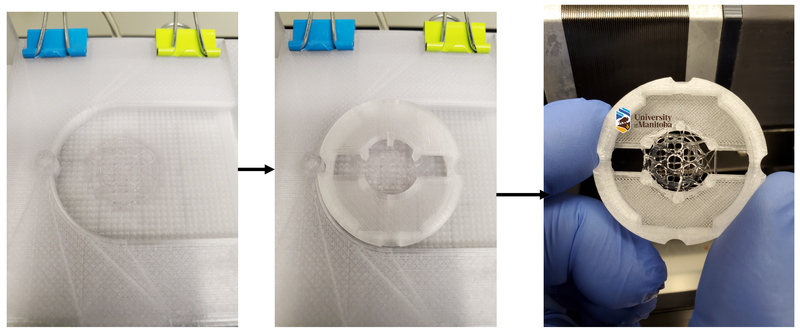
Spiderweb design bio-printed

## ACKNOWLEDGEMENTS

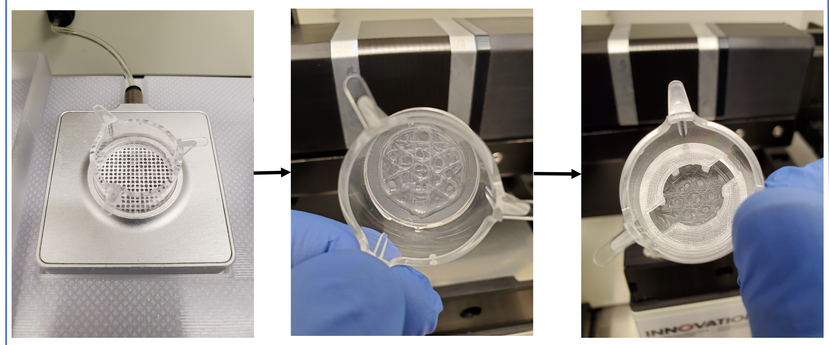

- Dr. Adrian West
- Emily Turner-Brannen
- Ahsen Haroon
- Lumiere Parrenas
- Umanitoba Undergraduate Research Award
- CHRIM

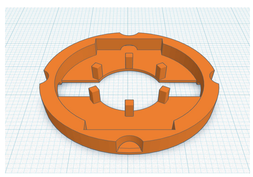

## METHOD

Slide Method: Muscle culture bio-printed onto a Nylon membrane, polycarbonate holder placed over spider web, then sliding sideways off the membrane and flipping onto holder.

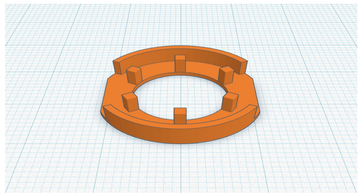


In-Transwell Method: Muscle culture bio-printed in a Transwell, polycarbonate holder placed on top to hold it in place and provide support.





Slide Holder Design computer model

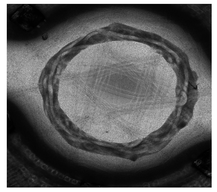


In-Transwell Holder Design computer model

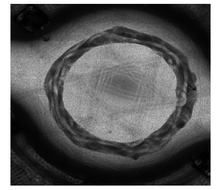
## RESULTS

The In-transwell method had a much higher rate of success with lower occurances of low fidelity prints, and a greatly reduced chance of human error and impact on structural integrity of ring over time. 90% success rate over time, versus 50% with the slide technique. In-Transwell prints were also viable for imaging and could be used for contractile assays as lower impact on structure integrity.

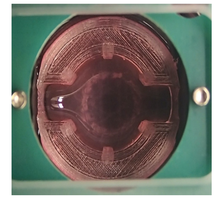
| Success? | Slide | In-Transwell |
|---|---|---|
| Success Rate | ~50% | >90% |
| Material pressure & Speed | 20-30% higher pressure & 5-10% lower speed | 20-30% lower pressure & 5-10% higher speed |



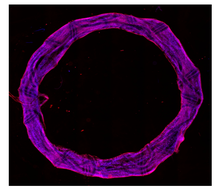
ASM Contraction Baseline



ASM KCl Contraction (3.3% reduction in lumen area)



Skeletal muscle ring in electrode plate.



Fixed fluorescence image of stained ASM ring (actin filaments in red, nuclei in blue)

## CONCLUSION

In-Transwell print for spiderwebs design muscle tissues was by far the superior methodology and will be employed in future prints. Due to higher tissue fidelity & ease of use as well as viability for cell imaging and contraction assays in airway smooth muscles. Also allowed for smoother prints due to high speeds and lower pressure.

Improvements still need to be made in the holder design and in a method so that the transwells can be used for skeletal muscle contractions.

Long term goal is to have an easy methodology that can be used to study and treat airway smooth muscle diseases such as asthma or skeletal muscle diseases like in cancers, or cardiac muscle and skeletal muscle diseases in diabetes.