



Modernization of Artificial Urinary Sphincter to Improve Quality of Life After Prostate Cancer Surgery (#2)



Selena Cao¹, Jenna Cecil¹, Kate Reimold¹, Mya Verrett¹, Dr. Jonathan Berger², Dr. Josiah Low², Dr. Nathaniel McLauchlan², Moreed Khosravanipour³

¹University of California, San Diego Shu Chien - Lay Department of Bioengineering

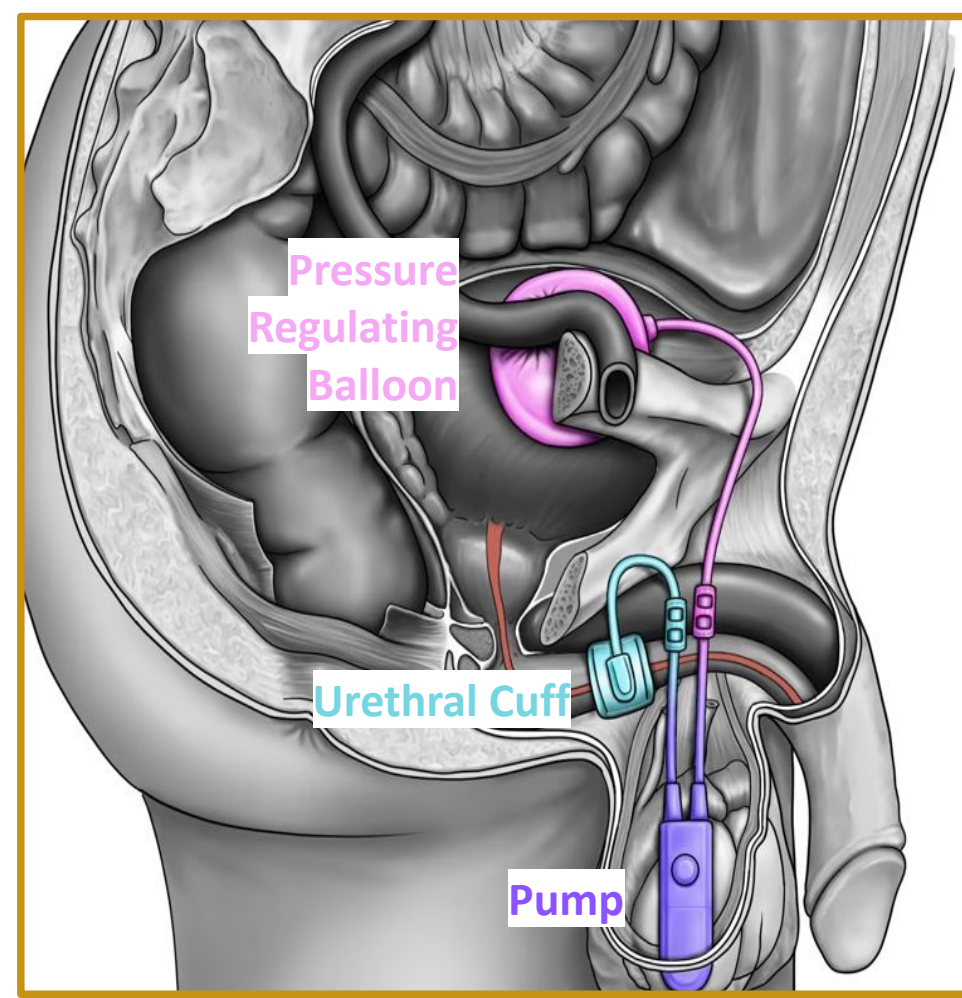
²Naval Medical Center San Diego, Department of Urology

³OXOS Medical

Background & Objectives

1 in 8 men* (12.8%) will develop prostate cancer during their lifetime¹. with 60% undergoing surgery (**radical prostatectomy**)² leading to urinary incontinence and reduced quality of life.

- The standard-of-care AMS 800™ **Artificial Urinary Sphincter** remains largely unchanged since the 1980s
- **Common issues** include device malfunction, fluid leakage, urethral erosion, and infection
- **At 5-10 years post-implantation, approximately 50% of devices require surgical revision**³



Objectives:

1. Develop a validated benchtop model to evaluate AUS cuff designs
2. Create FEA urethra model for cuff optimization
3. Prototype improved cuff designs that reduce erosion risk

Specifications

Benchtop Model:

- Generates 5-7.8 kPa pressure in the bladder
- Urethra interior should be fully compressible with minimal pressure applied (light touch)
- Should be able to fill with and expel water or saline

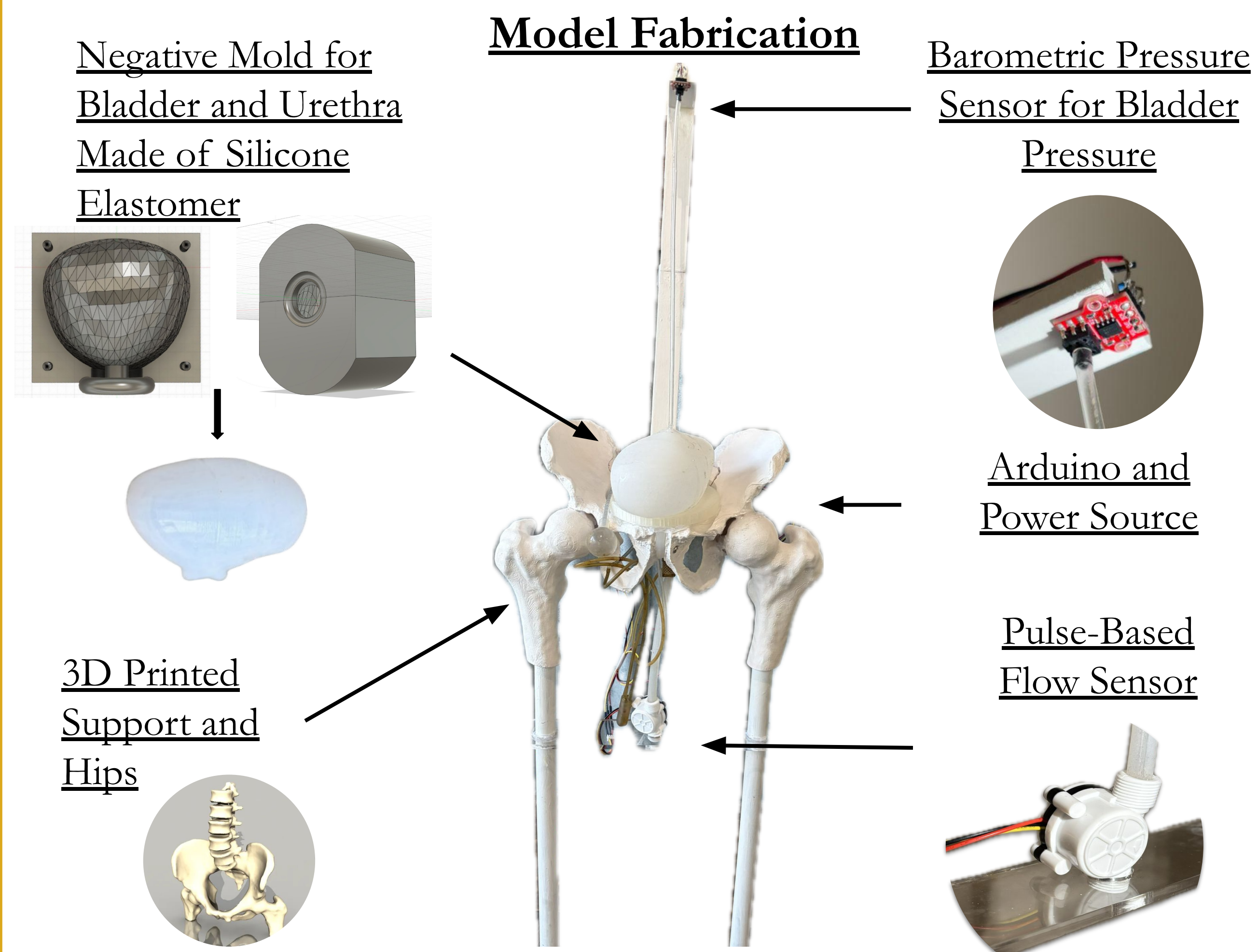
Cuff Specifications:

- Stop a minimum 5kPa of pressure through the urethra
- Distribute pressure over a minimum surface area of 157 mm²
- When bladder pressure is simulated, the leakage is stopped (leakage prevention)

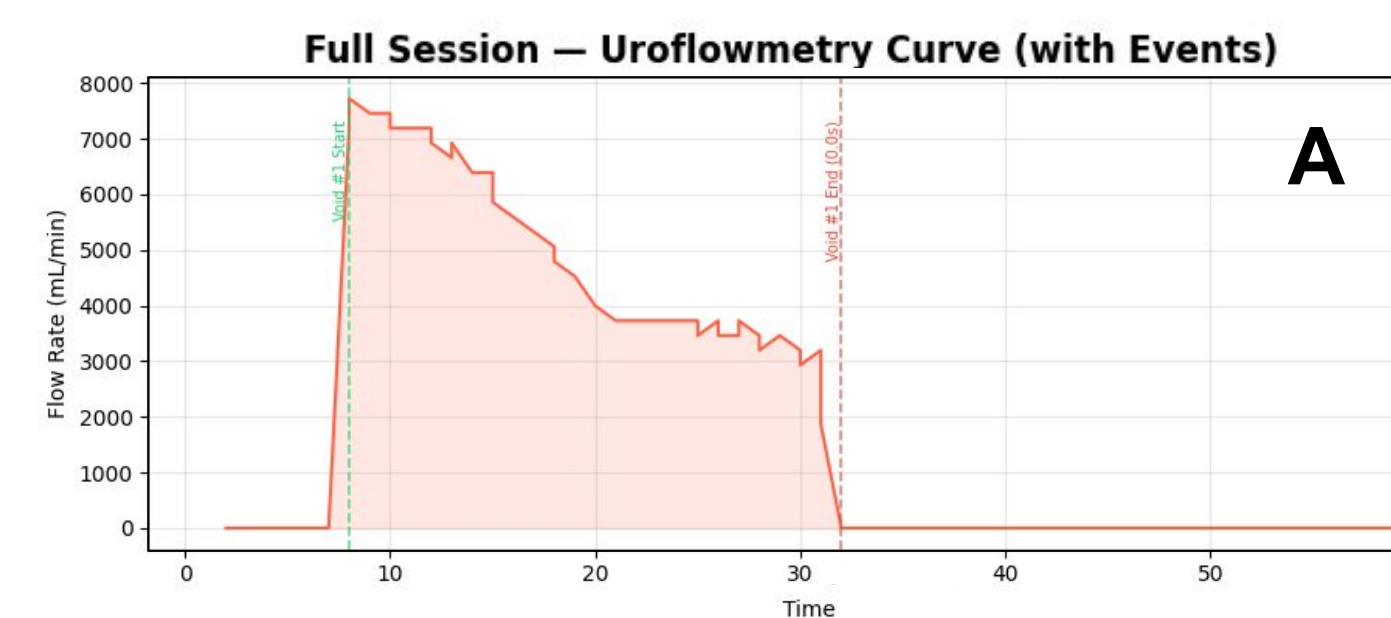
References:



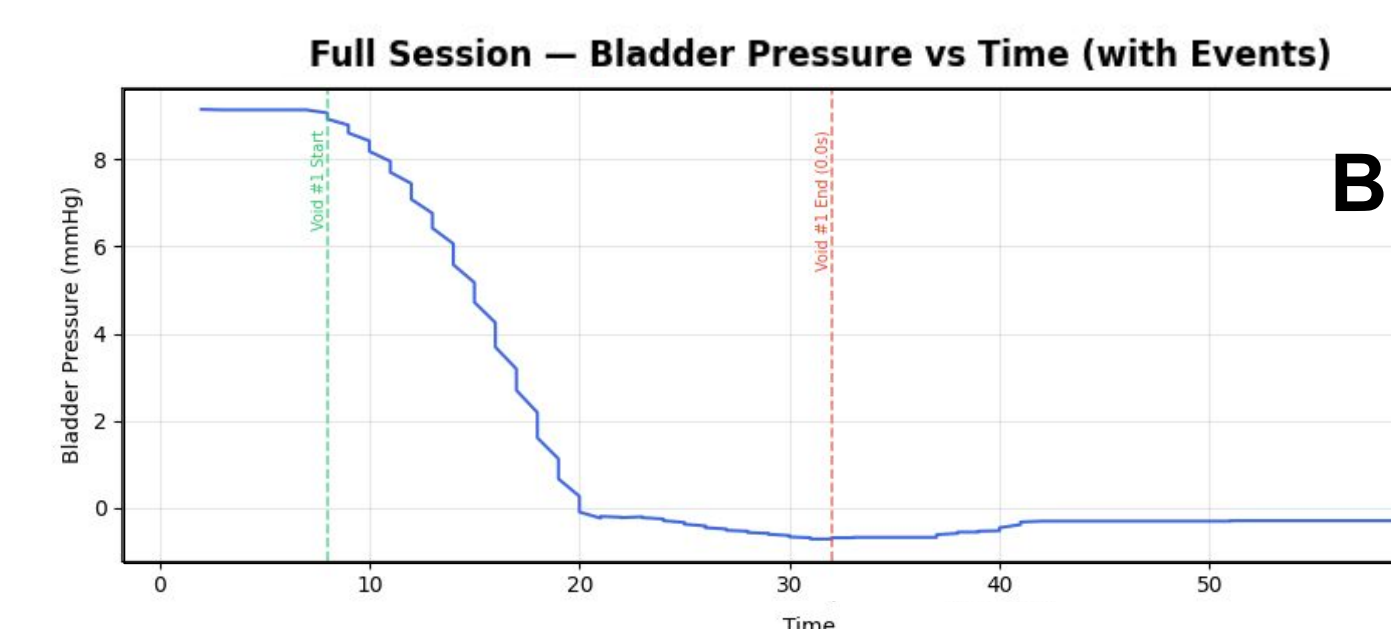
Benchtop Model



Bladder Pressure and Urine Flow Rate: Data Acquisition.

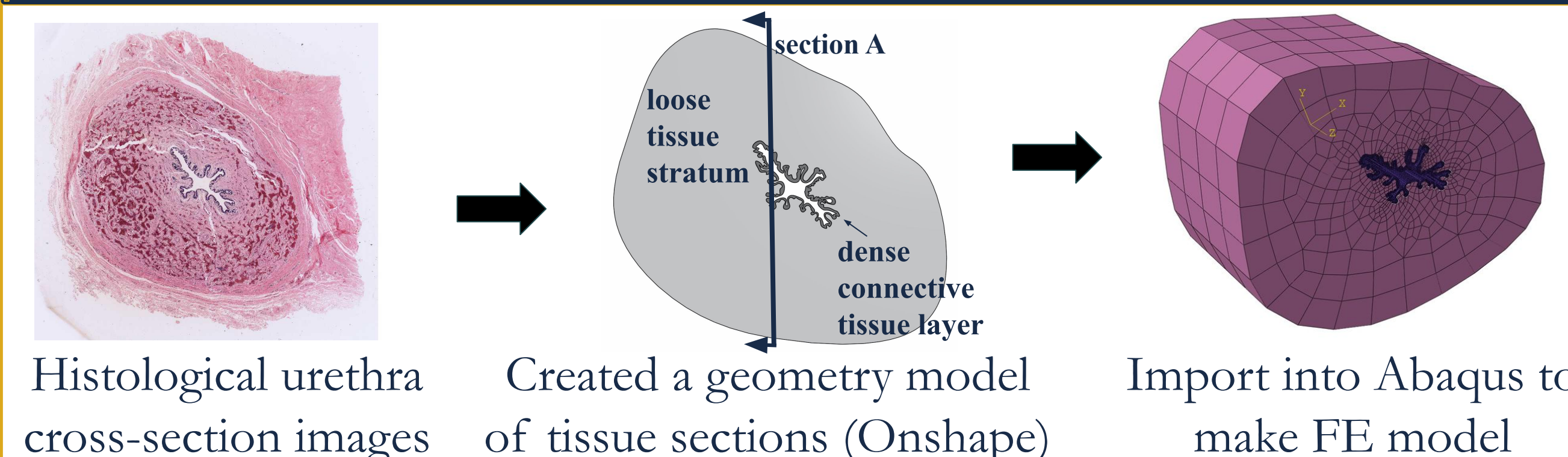


Simulated bladder pressure (Figure A) and urine flow rate (Figure B) monitored simultaneously during AMS 800 cuff activation.

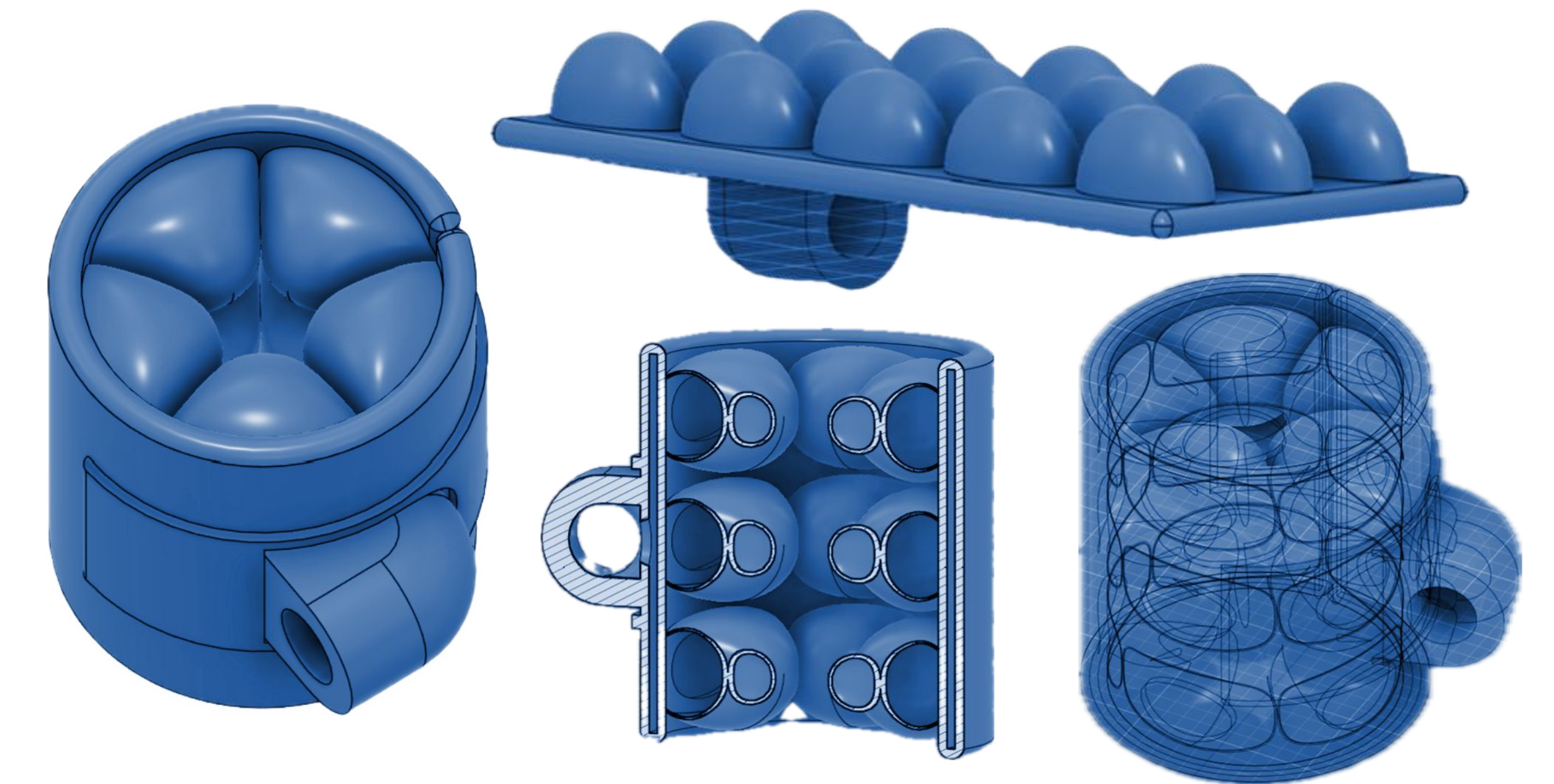


- Both sensors sampled at 10 Hz via Arduino-Python serial communication
- Automated event markers identified onset and cessation of voiding in real-time

Finite Element Urethra Model



Cuff Redesign



Current cuff design creates **localized high-pressure regions**, which may contribute to **urethral erosion** and **long-term device failure**.

This proof-of-concept redesign aims to:

1. **Distribute urethral compression** across 15 chambers
2. **Reduce tension** on individual seams in order to prevent rupture
3. Provide a model for subsequent **Finite Element Analysis**
4. Propose a design iteration to the current AUS device for validation

Conclusions & Future Directions

We developed:

- Benchtop model of male urinary physiology with pressure measurements/output for dynamic testing
- Proposed a new cuff design to reduce urethral tension and improve pressure distribution.

Future Directions:

- Manufacturing/fabrication of cuff design for experimental testing and validation on benchtop model
- Evaluate additional materials for cuff, improving longevity and stability

Acknowledgements

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