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BIOMECHANICS & BIOENGINEERING

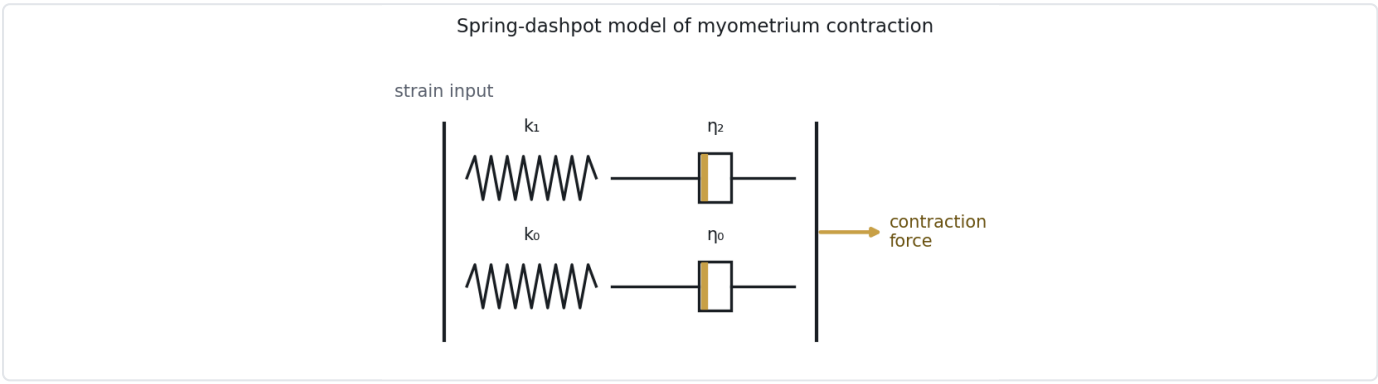
Biomechanics of Fibrotic Myometrium in Labor

University of Toronto, MIE439 · Team project, 2024

Co-lead: mechanical testing | Co-lead: mathematical modeling

Modeled how fibroids alter the uterine muscle's ability to generate labor forces.

This project investigated how uterine fibroids change the viscoelastic properties of the myometrium and its capacity to generate the forces of labor. I co-led the mechanical testing and the mathematical-model development. The team built tissue phantoms matching healthy and fibroid stiffness, ran tensile tests, and adapted a rheological model solved in MATLAB.



The spring-dashpot rheological model of myometrium contraction implemented in MATLAB.

Tissue phantoms and testing

Gelatin and polyvinyl-alcohol phantoms were fabricated to match healthy myometrium (about 40 kPa) and fibroid tissue (about 96 kPa) using a 20:80 gelatin-PVA freeze-thaw protocol, then tensile-tested against a representative labor load to extract stiffness and strength.

Rheological model

We adapted a spring-dashpot rheological model of myometrium contraction and solved it symbolically in MATLAB for healthy, diseased, and fibroid cases, fitting the model constants to stress-strain data and accounting for contraction frequency, intrauterine pressure, and fetal load.

SELECTED REFERENCES

- K. Jelen et al., "Rheological properties of myometrium," Neuro Endocrinol. Lett. 29(4), Sep 2008.
- M. Grimm, "Forces Involved with Labor and Delivery," Annals of Biomedical Engineering 49(8), Aug 2021.
- S. Sharma et al., "Characterizing Viscoelastic PVA Phantoms for Ultrasound Elastography," Ultrasound in Medicine & Biology, 2023.

Engineering portfolio brief. Course and team project; contribution as noted above.