The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

TOWARDS A TISSUE MODEL BASED ON TISSUE MECHANICS AND HISTOLOGICAL DATA

Pedro S. Martins[1*], Rita Rynkevic[2] and João P. Ferreira[3]

[1] ARAID, I3A, University of Zaragoza, Zaragoza, Spain, pedro.sousamartins@gmail.com, https://www.araid.es/en

[1, 2, 3] LAETA, INEGI, Faculty of Engineering, University of Porto, Porto, Portugal, {[2] r.rynkevic@gmail.com, [3] j.ferreira@fe.up.pt}, http://www.inegi.pt/en/

Keywords: *Vaginal Tissues, Finite Element Model, HGO strain energy function.*

The digitization of complex processes and systems is a requirement of the current industrial revolution, aimed to obtain virtual representations of physical objects, such as Digital Twins. This effort spans across industries and fields of knowledge, including the health sector. As a basis for more complex structures, an accurate virtual representation of biological soft tissues may open the possibility of virtualizing organs, systems (such as the urinary system) and ultimately individuals. In this context, a study of tissue mechanics (mechanical properties) when combined with histological data (tissue composition and structure) enables an improvement of conventional tissue simulations [1]. Moreover, this approach has led to simulation capabilities that that extend what typical Finite Element Model (FEM) simulations are able to achieve. In [2], Ferreira et al. were able to present successful simulations of vaginal tissue during ball burst tests, combining uniaxial tensile test data and histology analysis within an hyperelasticity theoretical framework (Holzapfel-Gasser-Ogden strain energy function). The simulation data (force and displacement) evidenced good correlation with the experimental results from ball burst tests. This approach which includes vaginal tissue geometry, mechanical properties and histological data, assembled into a FEM may be extended into more interactive and complex virtual representations. Such tools may bring alternative routes to reduce animal experimentation, for better surgical planning or disease modelling.

Acknowledgements: The authors gratefully acknowledge funding from projects MImBI - PTDC/EME-APL/29875/2017, PreCogFil - PTDC/EMD-EMD/2229/2020 and CyclicCell - PTDC/EME-APL/1342/2020 financed through FCT/FEDER/MCTES. The authors also acknowledge funding from project. This work was supported by FCT, through INEGI, under LAETA, project UIDB/50022/2020.

REFERENCES

[1] R. Rynkevic, J. Ferreira, P. Martins, et al., Linking hyperelastic theoretical models and experimental data of vaginal tissue through histological data. *J. Biomech.,* Vol. **82**, pp. 271–279, 2019.

[2] J. Ferreira, R. Rynkevic, P. Martins, et al. Predicting the mechanical response of the vaginal wall in ball burst tests based on histology. *J. Biomed. Mater. Res. B*, Vol. **5**, pp. 925–1933, 2019.