

# Investigating micromechanics of fresh biological tissues

At the University of Limerick

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In the world of tissue mechanics, advanced technologies are constantly pushing the boundaries of research, which enable scientists to explore areas that were once out of reach. One such area is the micromechanics of fresh biological tissues, where Clíona M. McCarthy, under the supervision of Dr. John J.E. Mulvihill at the University of Limerick, is breaking new ground in her PhD thesis on *ex vivo* tissue<sup>1</sup>, such as colonic<sup>2</sup> and vascular tissues, using the Chiaro indenter from Optics11 Life.

## The shift from macroscale to microscale testing

During our conversation, McCarthy emphasized the limitations of traditional macroscale mechanical testing. “Macroscale testing often fails to detect regional mechanical variations in soft biological tissues,” she explained. Here is where microscale testing comes into play. “Microscale testing allows you to examine disease progression in healthy tissue, focusing on tiny changes in the tissue environment,” she added.

McCarthy also noted that while microscale testing tools were initially developed for engineered materials, the Chiaro indenter is specifically designed for soft, fresh biological tissues. “There’s definitely a shift towards microscale testing in both industry and academia across different types of materials—cells, tissues, hydrogels—and application areas,” she observed.

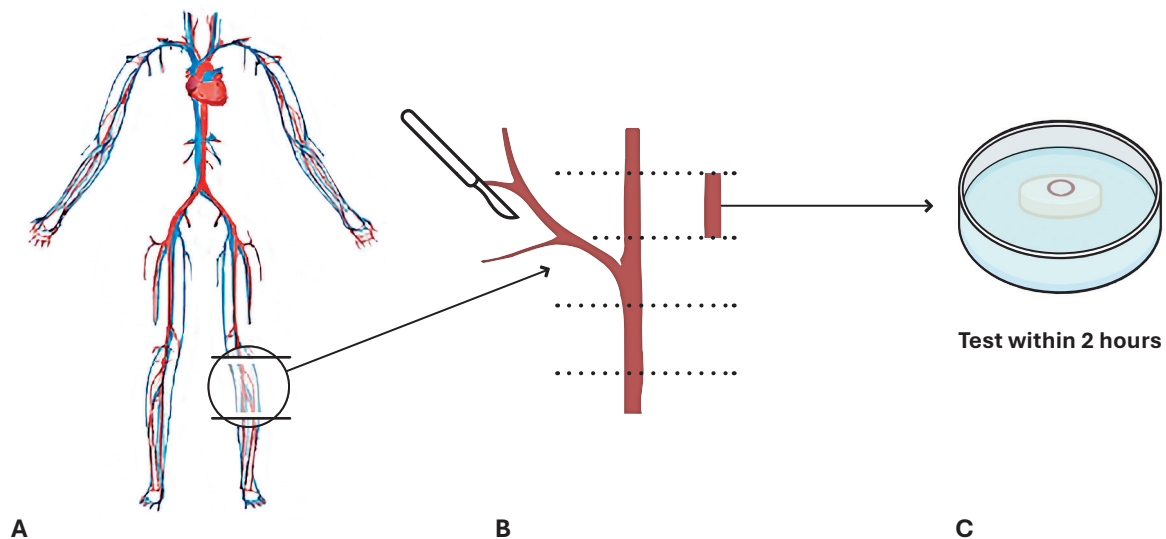
## The importance of testing fresh tissues

McCarthy’s research relies heavily on fresh, unfixed tissues. Testing fixed or frozen tissues, such as carotid and femoral plaques, can introduce alterations that misrepresent in vivo physiological conditions. She added, “With Chiaro’s expanded stiffness range, I can quickly test several fresh plaques without processing them.”

This approach is critical because biological materials exhibit viscoelastic behavior. One of Chiaro’s standout features is the Dynamic mechanical analysis (DMA) that assesses the viscoelastic properties of various *ex vivo* and engineered tissues to investigate disease progression, as modulus measurements differ between healthy and diseased tissues. McCarthy believes that DMA capability significantly enhances biomimetic models designed to mimic the mechanical properties of living tissues. “In the literature, most biomimetic modeling is based on purely elastic materials. I would expect better 3D biomimetic models with their viscoelastic properties evaluated,” she explained.

## Streamlining the research process

Beyond its advanced testing capabilities, the Chiaro indenter also offers a user-friendly data visualization tool that McCarthy appreciates. “Most data processing is very manual and time-consuming, especially when calculating properties like Young’s Modulus. Chiaro’s data viewer software simplifies this process, allowing me to focus on analyzing the data rather than spending hours processing it,” she shared.



^ **Figure 1**

Example of tissue preparation for microindentation using human vascular tissue. **(a)** Human tissue is obtained on the day of surgery. **(b)** A region of tissue is isolated and cut for microindentation. **(c)** The tissue section is mounted onto the liquid agarose and gelatin embedding solution. The tissue is hydrated in 1X PBS before microindentation.

Note. Adapted from “Microindentation of fresh soft biological tissue: A rapid tissue sectioning and mounting protocol”, McCarthy, CM, 2024, PLoS One. 2024 Feb 29;19(2):e0297618. doi: 10.1371/journal.pone.0297618. © 2024 McCarthy et al. This is an open access article distributed under the terms of the CC BY 4.0.

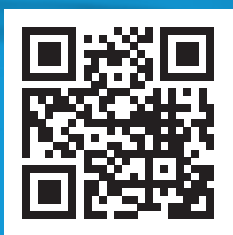
## Revolutionary micromechanical testings for disease development

As our conversation wrapped up, it was clear that the Optics11 Life’s indenters are revolutionizing the mechanical testing of soft, fresh tissues at the microscale. Their dynamic analysis and efficient data visualization tools enhance accuracy and streamline research, making them invaluable assets for advancing preclinical studies on tissue mechanics during disease development.

But as McCarthy pointed out, it’s not just about technology. “Optics11 Life is committed to ensuring that users have an excellent understanding of what they are working with,” she said, praising the customer and application support provided by the qualified application specialists at Optics11 Life.

### References

- 1 **McCarthy CM, et al.** Comparison of macroscale and microscale mechanical properties of fresh and fixed-frozen porcine colonic tissue. *J Mech Behav Biomed Mater.* 2023 Feb;138:105599. doi: 10.1016/j.jmbbm.2022.105599.
- 2 **McCarthy CM, et al.** Microindentation of fresh soft biological tissue: A rapid tissue sectioning and mounting protocol. *PLoS One.* 2024 Feb 29;19(2):e0297618. doi: 10.1371/journal.pone.0297618.



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