Microtissue Softness Tester

Application of compressive stress to small specimens

November 2018

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Stiffness is a mechanical property

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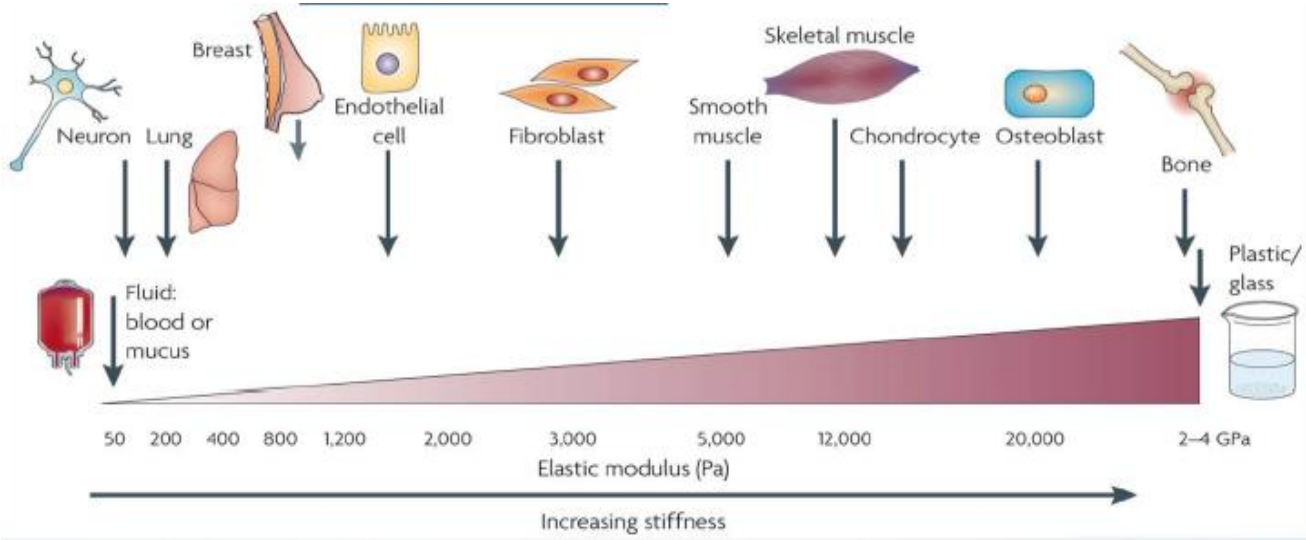
Context

- Living tissues stiffness is linked to physiological functions



- Pathologies can modify tissues stiffness such as:
  - Tumors
  - Fibrosis
  - Cirrhotic liver

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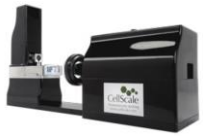
Existing solutions

- Nanoindentation/Atomic Force Microscopy:
  - Hard or soft samples in thin layer (2D cell cultures)
  - 300 nm to 100 µm
  - Single cell scale

→ Size sample limitation

- Microsquisher (CellScale):
  - Soft samples (microtissues)
  - 200µm
  - Drawbacks:
    - Need to change cantilever depending on the sample nature
    - Welded to the optic bench
    - Indirect measurement of the exerted pressure



→ Ease-of-use limitation

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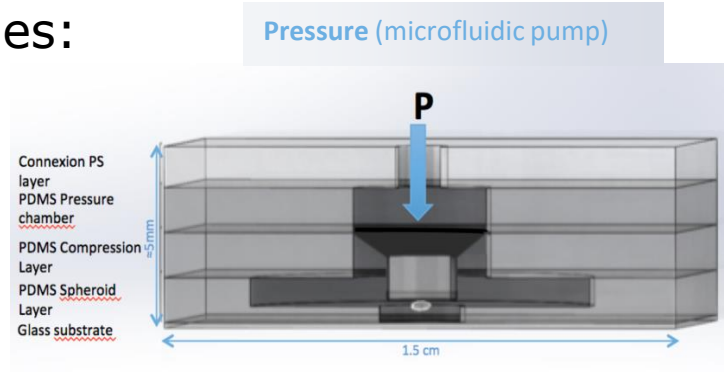
Invention

- New compression device for soft tissues:



  - Living tissue samples
  - Size varying from 500µm to 8mm
  - Cylindrical shape
  - Device made of polydimethylsiloxane (PDMS, silicone)
  - Stiffness and relaxation measurement
  - Direct measurement of the pressure applied to the sample

<u>Potential development:</u>
Integrable to any optic bench for microscopy analysis

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Invention's principles

1. Mechanical test:

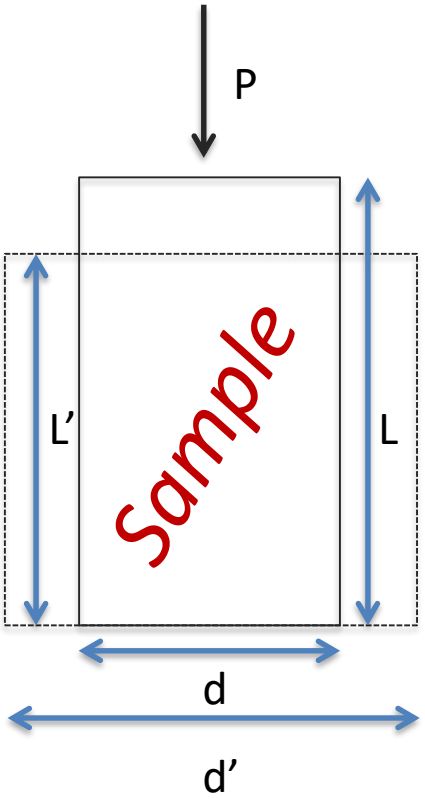
- Compression of the sample with a controlled and measured pressure P.

2. Image analysis:

- Registration of the shape of the sample during compression test
- Monitoring of the deformation of the sample (L, L', d & d').

3. Access to mechanical parameters:

- Young modulus (elasticity);
- Poisson's ratio (incompressibility).



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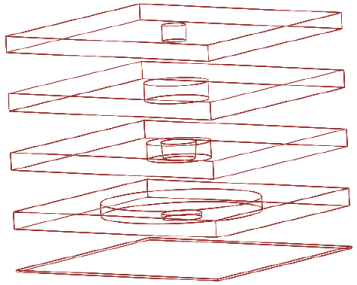
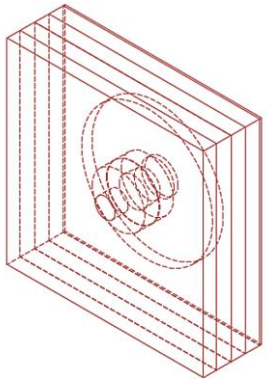
Invention's advantages





- Non-destructive method
- Adaptable to a large range of sample sizes
- Easy to use
- Low production cost

<u>Potential developments:</u>

- *Compatible with any kind of imaging instrument;*
- *Adaptable to liquid environment;*
- *Parallelisable.*

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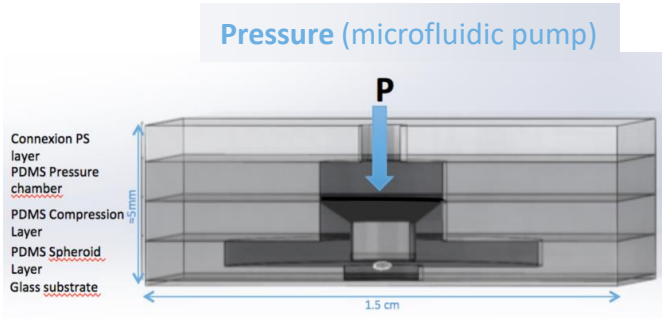
Potential applications

Biological tissues characterisation
(healthy *vs* pathological – treatment effect)

Material characterisation
(tissue engineering)



Skin stiffness test
(dermocosmetics)

New substitution material design

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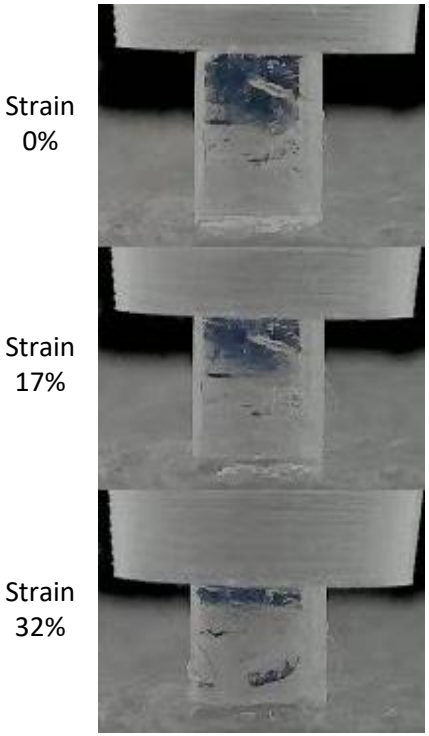
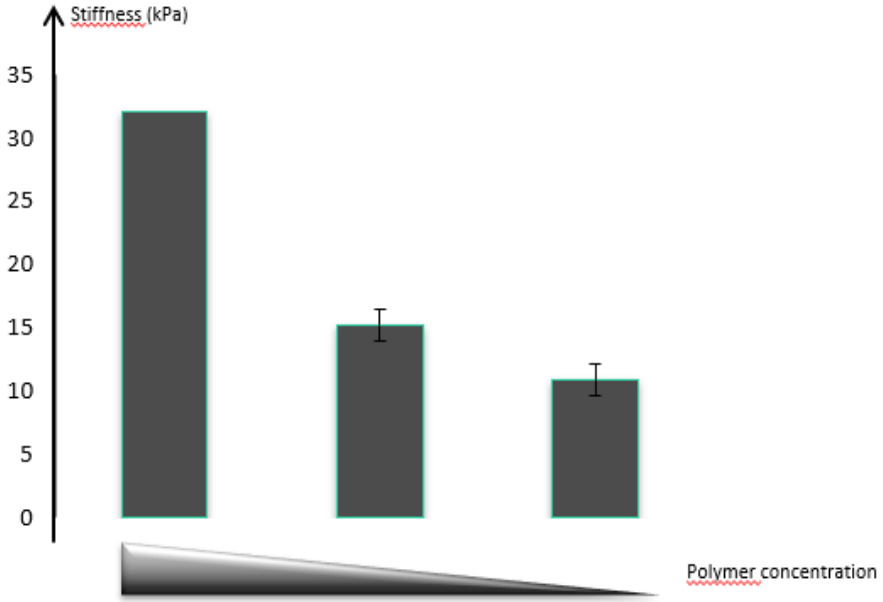
Material characterisation: Tests with agarose

- Characterization of agarose gel at various concentrations:





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Biological tissues characterisation: Tests on fresh biopsies

- Biopsies elasticity measurement:

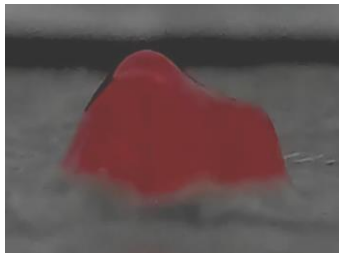
Adipose tissue: E= 9,27 kPa

(Video)

Liver tissue: E= 28,67kPa

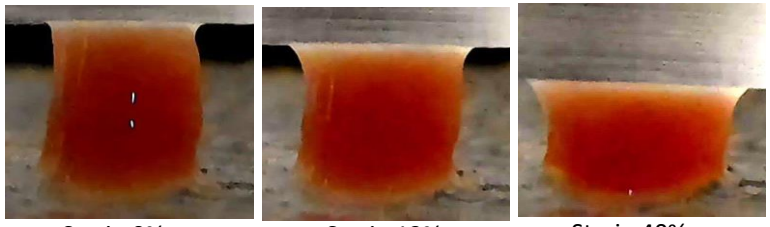
(Video)

Lung tissue: E= 13,87kPa

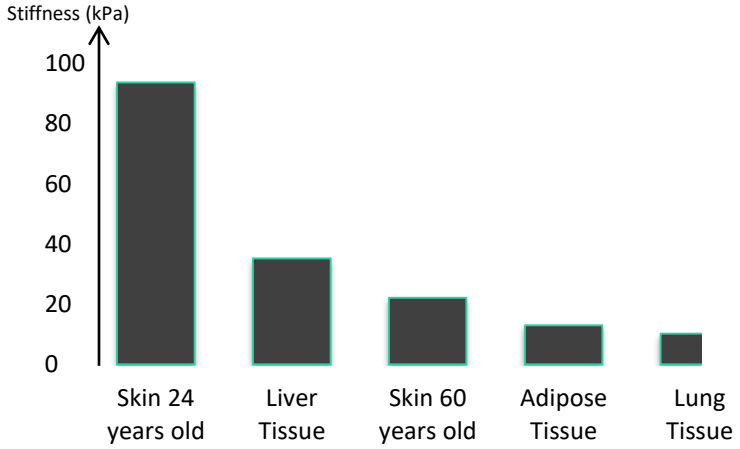


(Video)

Example of liver biopsy compression



Strain 0% Strain 13% Strain 40%



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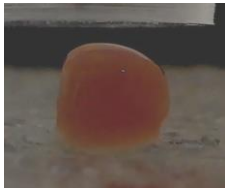
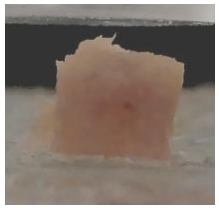
Biological tissues characterisation: Tests on modified tissues

- Tissue stiffness modification monitoring:



(Video)

Liver: E = 28,67 kPa

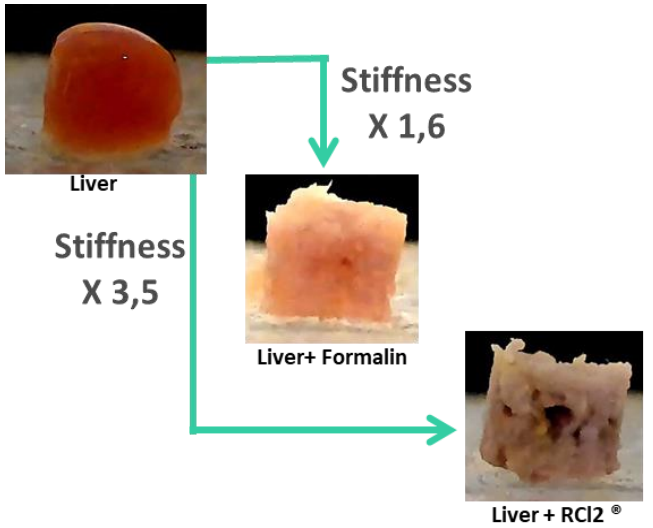


(Video)

Liver + Formalin:
E = 47,41 kPa

(Video)

Liver + RCL2 ®:
E = 61,64 kPa



➔ Potentially applicable to evaluation of the effect of pharmacological treatments on tissue mechanical properties (skin, muscle tissue, etc.).

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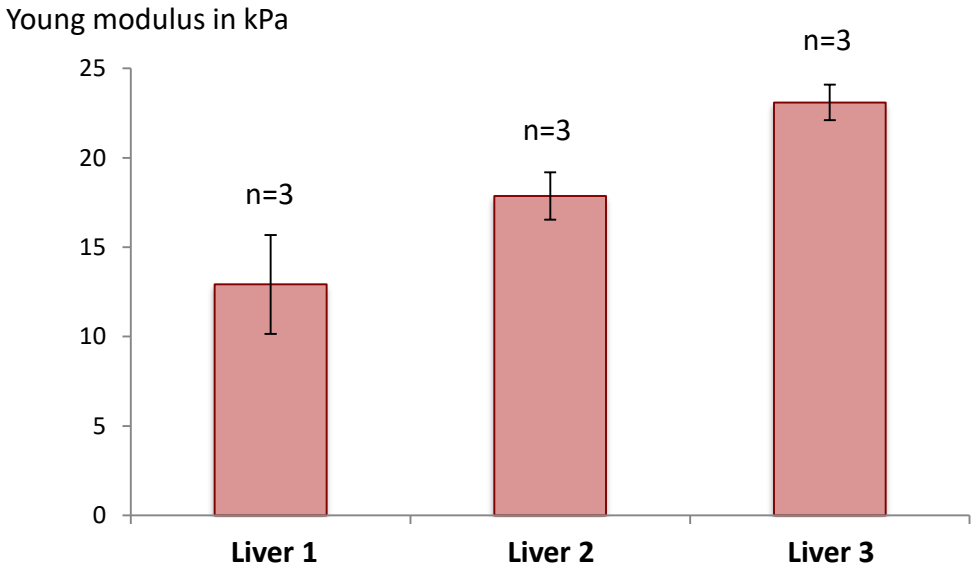
Biological tissues characterization: Chicken liver properties

- Evidence for change in mechanical properties associated with macroscopic variations



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Intellectual property

- French patent application filed on the 21st of September 2017
- Co-owners:

- Labs:

- Contact: Claire METAIS

  Business Manager, Toulouse Tech Transfer

  metais@toulouse-tech-transfer.com

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