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# Innovative instrumentation for assessing the mechanical properties of skin

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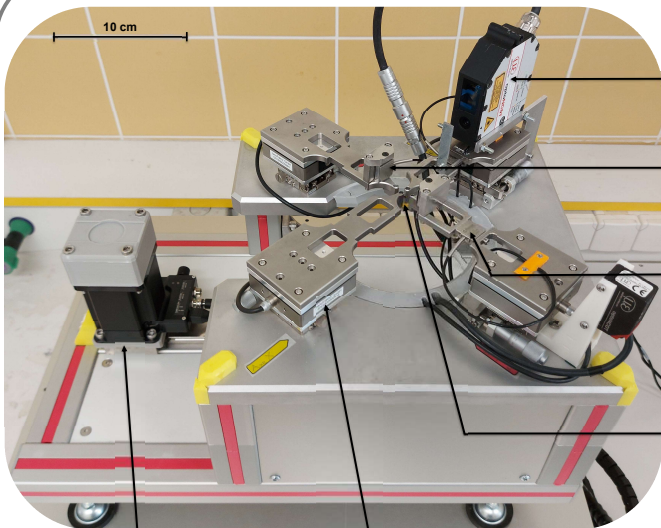
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## I. Abstract

A specific instrument to assess the **viscoelastic properties** of human skin has been developed in this project. This innovative **technology** combined with the use of **ex vivo human skin explants** under physiological conditions for several days, should enable to help for the development of products intended for treatments. Indeed, we propose to analyse and evaluate in an objective way:

- the effects of different **external stresses** (stretch marks, UV rays exposure, chemical exposure, air pollution, injuries, freezing, etc.)
- the effects of **medical or dermo-cosmetic products** (moisturising creams, anti-stretch mark creams, healing dressings, etc.) on the viscoelastic properties of human skin.

## II. Instrumentation



Motorised **sample holder** for preparing and moving the *ex vivo* skin explant

**Piezoelectric actuator** for moving the arms

**Laser position sensor** for measuring arm movement

**Vertical force sensor** for measuring the compression force applied to the skin explant

**Horizontal force sensor** for measuring the tensile force exerted on the skin explant

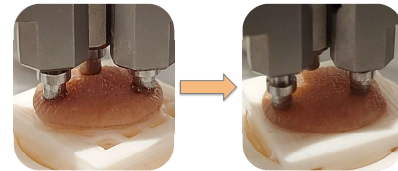
**Stainless steel stud** for gluing the skin explant to the technology arms

## III. Studies conducted

### A) Effect of enzymatic stress

- ➔ Explants are exposed to enzymes that degrade dermal fibres: collagenases and elastases
- ➔ Stress that allows to mimic an accelerated ageing of the skin

**Protocol:** 1. Mechanical tests at D0 before stress  
2. Introduction of enzymes into the culture medium of the skin  
3. Mechanical tests at D+2



*Ex vivo* skin explant before (left) and after (right) stress

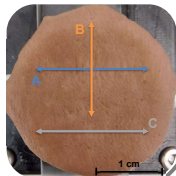
### B) Mechanical properties of stretch marks

- ➔ Study of the differences in mechanical properties in a skin explant with stretch marks

**Protocol:**

Mechanical tests on 3 areas of the explants :

- A = in the stretch mark
- B = // streaks of the stretch mark
- C = healthy area

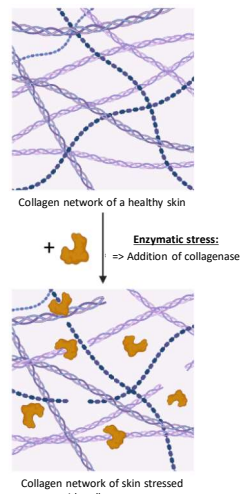
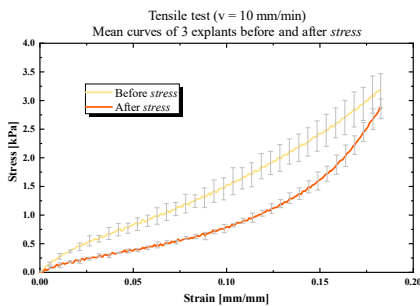


## IV. Results

### A) Effect of enzymatic stress

➔ Mechanical test

➔ Schematic illustration

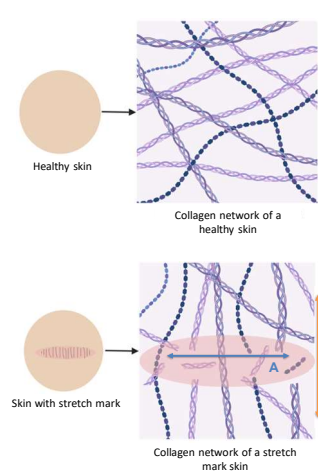
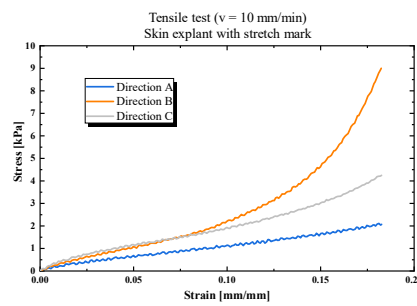


- ➔ Significant change in the mechanical behaviour of skin explants when exposed to enzymatic stress.
- ➔ Mechanical tests show that the skin loses its mechanical properties when exposed to enzymatic stress.
- ➔ At low deformations, the stiffness and viscoelastic properties of the skin are reduced.

### B) Mechanical properties of stretch marks

➔ Mechanical test

➔ Schematic illustration



- ➔ Differences in mechanical properties induced by stretch marks on the skin :
  - Higher mechanical properties in the direction parallel to the streaks of the stretch mark (direction where the fibres are pre-oriented = dir. B)
  - Lower mechanical properties in the stretch mark (fibre breakage area = dir. A)

## V. Conclusion

### Progress of the project

- ✓ A **new instrumentation** to evaluate and characterise the mechanical properties of **ex vivo human skin explants** has been developed.
- ✓ Previous results have demonstrated the **robustness** and **ability** of the technology to accurately explore the mechanical properties of human skin explants without stress.
- ✓ These new studies demonstrate that the technology can measure differences in mechanical properties within **injured skin** and can also assess the **effect of stress** on the skin over time.

### Reference

[1] Patent WO 2022/129813 A1

### Perspectives & Applications

- ➔ To **confirm the results of enzymatic stress** in a more complete study: control skin + stressed skin + stressed skin with stress inhibitor.
- ➔ To validate and support the mechanical results by performing **histological sections** of skin explants.
- ➔ To carry out new studies to evaluate the **effects of different stresses** and wound healing on the mechanical properties of human skin.



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