Micropattern effects on the mechanical properties of a multi-material 3D printed dressing for chronic wound treatments

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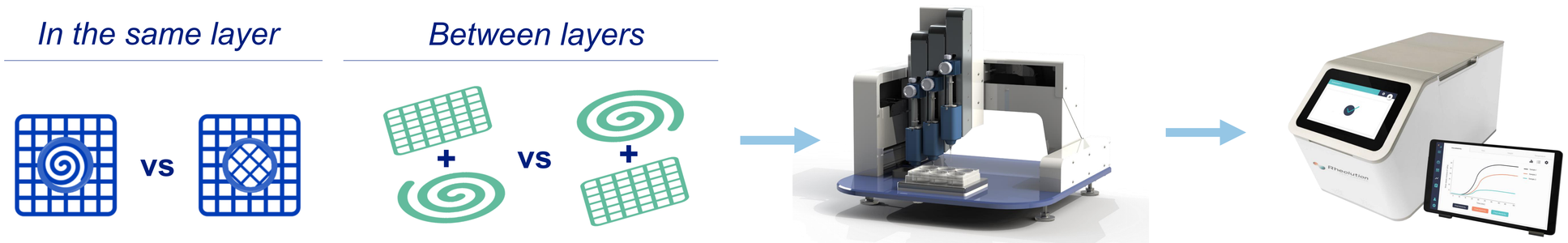
Introduction:

FORCE REPAIR, an EU-funded research project, is developing a multifunctional wound dressing based on hyaluronic acid dynamic hydrogels to create a pro-regenerative environment and ensure mechanical stability during chronic wound treatment. The project aims to print multi-material patches tailored to patients' needs. In this preliminary study, we establish the methodology to evaluate how different micropatterns affect the viscoelastic properties of the printed patches. These micropatterns are applied within defined sub-volumes, following a specific spatial distribution hierarchy designed to enhance the healing process.

Methodology:



Model and micropattern design | **3D Printing** | **Testing**

Results and Discussion:

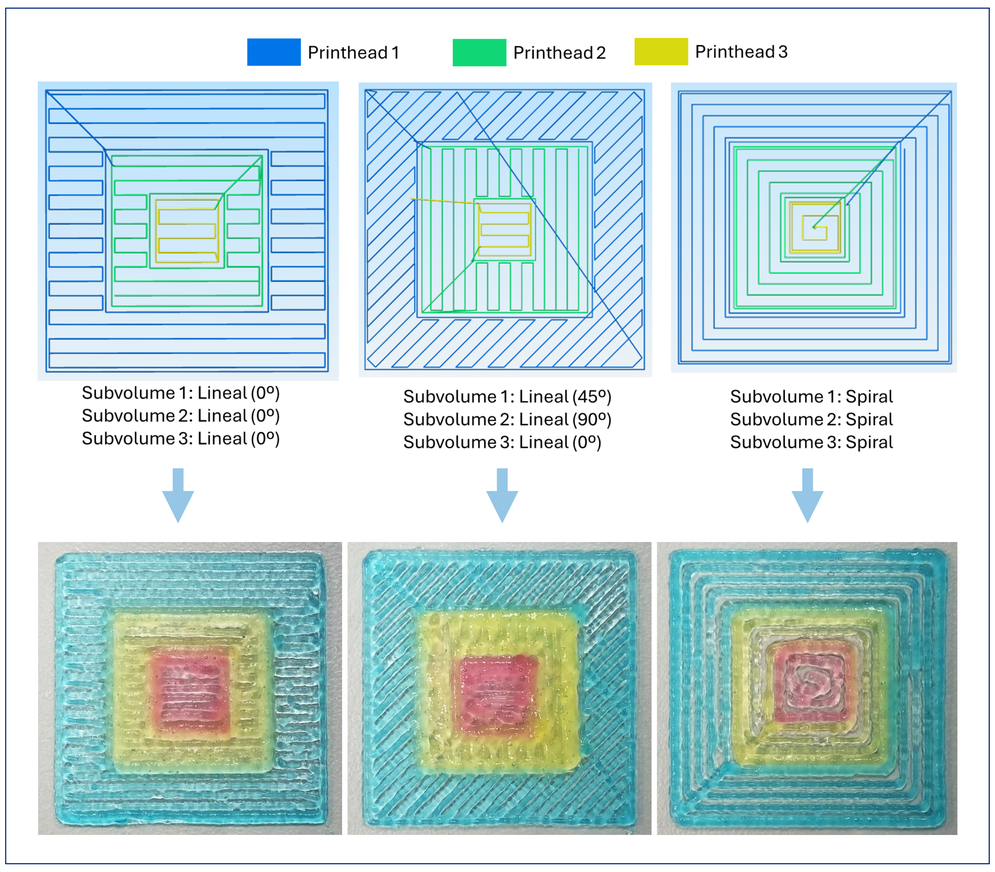


Figure 1. Preview of the subvolume designs with distinct micropatterns and their successful multi-material printing.

Using the custom-designed path-planning software, we created and successfully printed three patch models with distinct micropatterns, combining three inks simultaneously (Fig. 1). For Elastosens™ measurements, micropatterned patches were printed directly onto the holders (Fig. 2), exploring two approaches: varying the pattern within the same layer or across successive layers. Designs with circular patterns at the base or centre showed higher G' values than those with purely rectilinear subdivisions (Fig. 3).

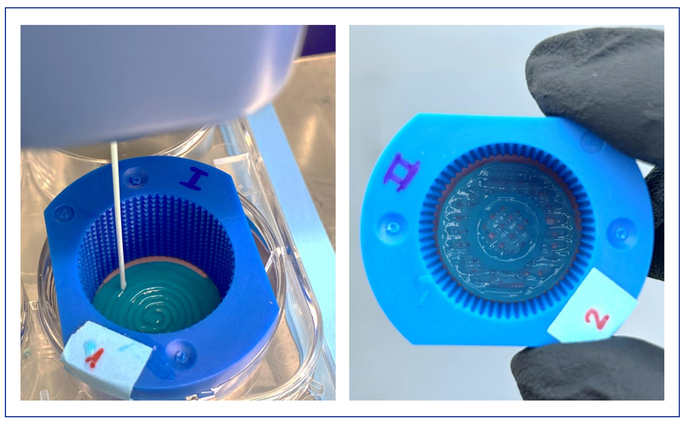


Figure 2. Direct printing onto measurement holders for characterization.

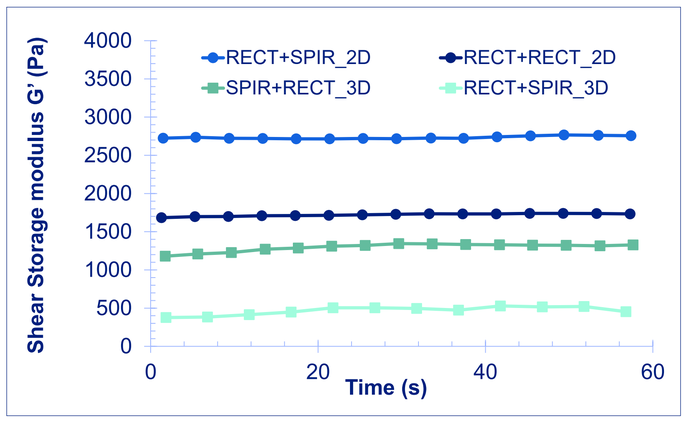


Figure 3. Storage modulus (G') values for the tested micropatterns.

Conclusions:

This preliminary study establishes the basis for a methodology to assess the mechanical behaviour of micropatterned hydrogels. Initial tests demonstrate that pattern geometry influences stiffness, highlighting the potential of this approach for guiding the design of future wound dressings.

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