Skin tissue engineering research aims to develop functional skin substitutes that closely mimic the structure, function, and appearance of natural skin. This involves creating scaffolds using biomaterials that replicate the extracellular matrix of the skin, providing a framework for cell growth and organization similar to natural tissue [1].

The aim of this work is to study different structures for tissue engineering scaffolds that incorporate micro-scale auxetic designs and observe the variation in the overall mechanical behavior influenced by changing their geometrical parameters. (Figure 2)

The parametric study focuses on key geometric parameters, such as fiber length (A, B) and angle between fibers (α). Different values are combined for each parameter, taking into account the necessary conditions to ensure the viability of the design. (Figure 3)

Mechanical properties of the scaffolds are determined from the forces and displacements of the numerical simulations. These data are used to calculate important parameters such as the elastic modulus, stress-strain curves, and Poisson’s ratio. These values are then compared with appropriate skin scaffold mechanical properties obtained from literature [5,6]. (Table 1)

A) Auxetic structures: exceptional shape adaptability [3]
B) Tailorable mechanical properties

According to parametric study, Biodegradable scaffolds exhibit highly porous properties (allows cell migration, proliferation and nutrition-waste exchange). These scaffolds are suitable for skin tissue engineering applications and can be used to replicate the mechanical behavior of natural skin, thereby offering effective mechanical support for skin tissue engineering applications. (Figure 1)

The mechanical behavior of scaffolds is dependent on the specific auxetic micro-design selected.
Alterations in the geometrical parameters of the design enable the customization and adjustment of the mechanical properties of the scaffold.
Auxetic scaffolds have demonstrated the ability to exhibit “J-shaped” stress-strain curves, which are typical of soft tissues, like skin. (Figure 4)

CONCLUSIONS

- The mechanical behavior of scaffolds is dependent on the specific auxetic micro-design selected.
- Alterations in the geometrical parameters of the design enable the customization and adjustment of the mechanical properties of the scaffold.
- Auxetic scaffolds have demonstrated the ability to replicate the mechanical behavior of natural skin, thereby offering effective mechanical support for skin tissue engineering applications.

References

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