


ESR 9

Project title and research strand:	Elastin-inspired fibres for aortic heart valves. Strand 2: Fibres for medical application.	
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Abstract

Over the last 30 years, tissue-engineered heart valves target to a replacement that is able to remodel and grow with the patient, reducing the risk of multiple surgeries caused by the current commercially available heart valve substitutes. However, this field of research is still ongoing and few attempts have been done towards a complete growing valve, although a clinically viable tissue-engineered heart valve has yet to be developed (Nachlas et al., 2017; Stassen et al., 2017). Therefore, the use of biological materials to mimic the native tissue is compelling. Herein, we propose a novel biohybrid aortic valve composed of Elastin-Like Recombinamers to resemble the extracellular matrix that compose the native tissue and Native-Like Silk Fibroin (NLFS) fibers to mechanically support the valve performance, in an analogous manner to the collagen fibers. These two biological materials were successfully combined in a tubular shape that exhibited a modulation of the anisotropic behaviour according to the change of the NLFS fibers angle (5°, 15°, 25° and 45°). Subsequently, the most suitable, that matches biological and mechanical properties, was selected to be fashioned in a valve and subjected to aortic conditions to further evaluate its performance. The biohybrid aortic valve met the regulations imposed by the ISO guidelines for heart valve replacement with transcatheter techniques, proving its capability to be a candidate for aortic valve replacement in order to overcome the limitations for the commercially ones and guarantee a better quality of life to the patients.

FIBER-REINFORCED ELASTIN-LIKE RECOMBINAMERS WITH BIOMIMETIC ANISOTROPIC BEHAVIOR FOR TISSUE-ENGINEERED HEART VALVES

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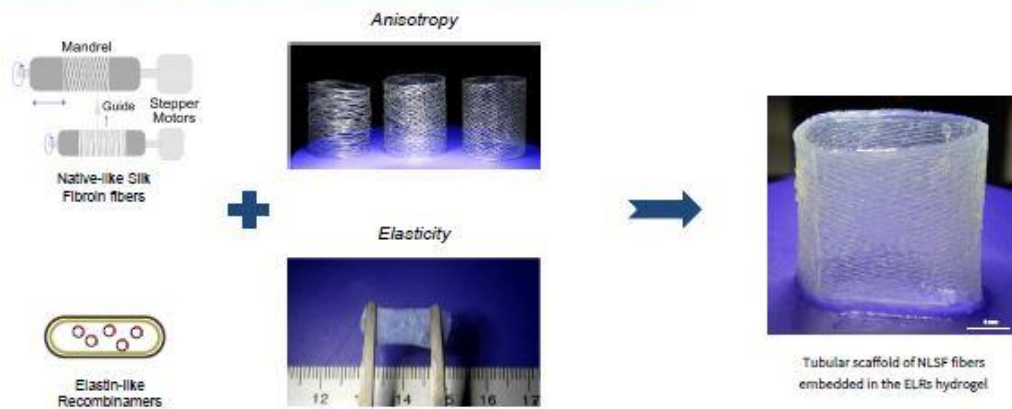
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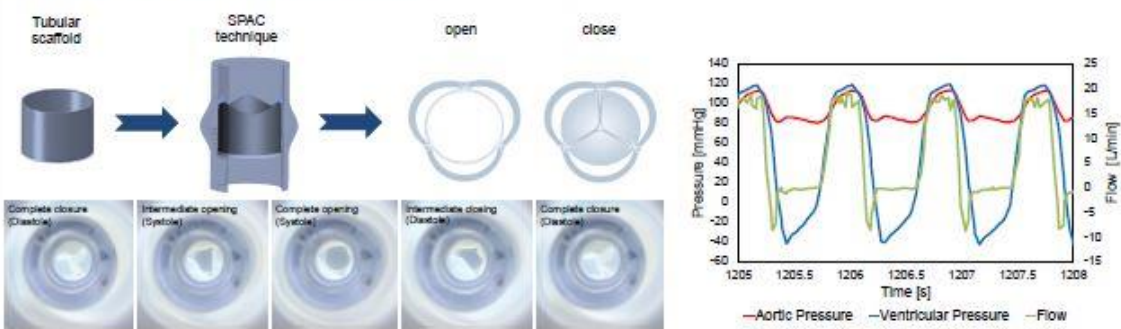
Introduction

Tissue-engineered heart valve aims to overcome the drawbacks of the commercially available heart replacement, representing a promising alternative with the capacity to remodel and potentially grow with the patient. Up to date, it is still complex to combine in a single implant the required biological (e.g. ECM production and hemocompatibility) and mechanical properties (e.g. anisotropy and elasticity), needed for optimal functionality. In order to proceed in this direction, here we developed Native-Like Silk Fibroin fiber-reinforced Elastin-Like tubular scaffolds for the development of an aortic heart valve (HV), following the single-point attached commissures (SPAC) technique.

Biofabrication of tubular scaffold reinforced with winding fibers at different angles



Fashioning of the HV and *in vitro* hydrodynamics



Regurgitation: $12.92 \pm 0.61 \%$
 Calculated EOA: $1.37 \pm 0.09 \text{ cm}^2$
 Transvalvular Mean Pressure Gradient: $6.23 \pm 0.28 \text{ mmHg}$

Conclusion

- ✓ The injection moulding resulted in a homogeneous Elastin-Like hydrogel, in which the NLSF fiber-reinforcement of different angles were completely embedded
- ✓ The biofabrication was systematically applied to produce biohybrid scaffolds able to modulate the anisotropy
- ✓ The biohybrid scaffold resulted to be a promising alternative supported by its performance under aortic condition, in accordance with the ISO 5840 - 1, 2, 3

Acknowledgements

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