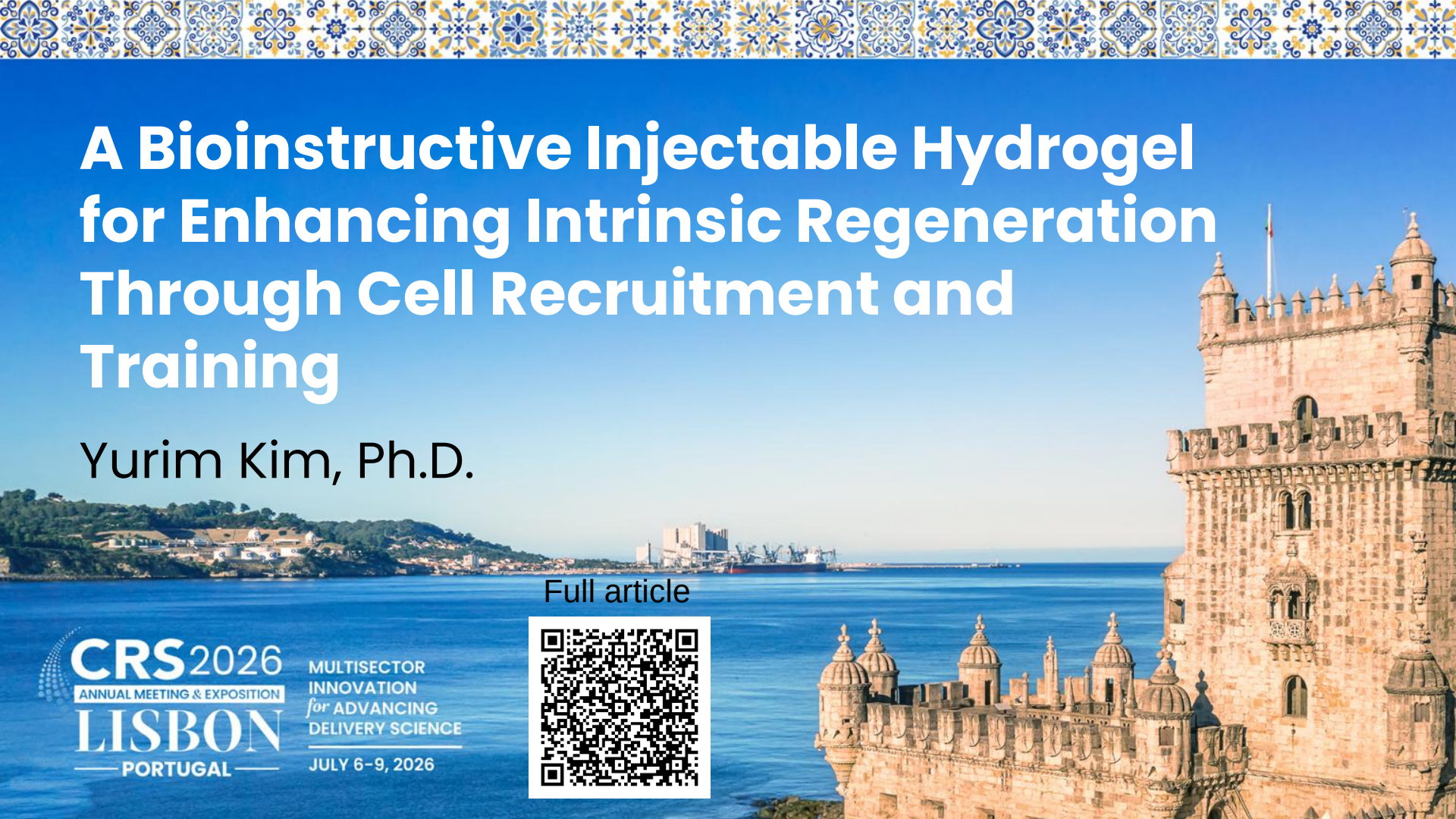
A Bioinstructive Injectable Hydrogel for Enhancing Intrinsic Regeneration Through Cell Recruitment and Training

Yurim Kim, Ph.D.



Full article

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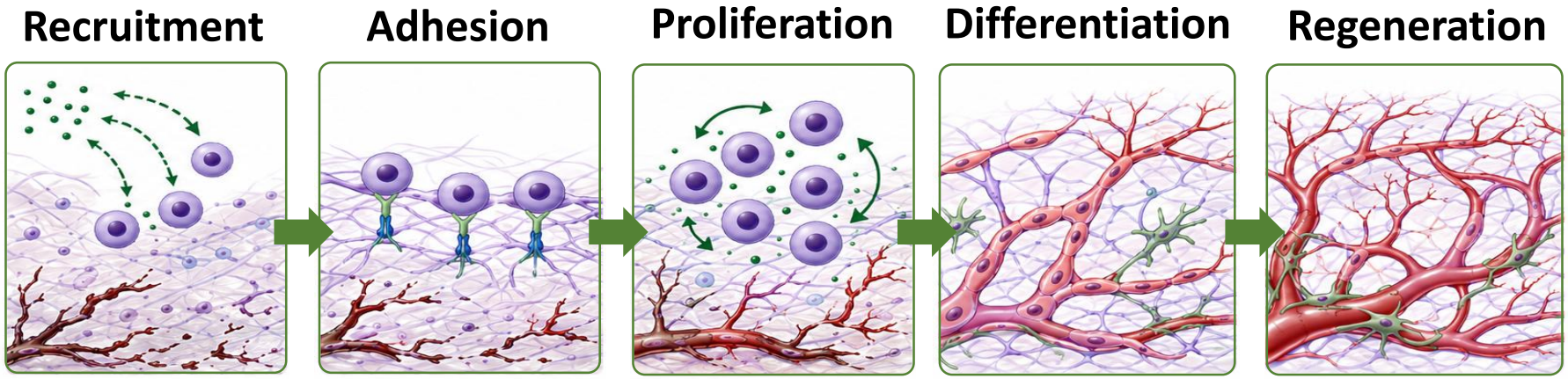
Introduction

Tissue Regeneration Requires a Complete Repair Cascade



However, conventional biomaterials often target isolated steps of regeneration

Failure at any step compromises tissue repair

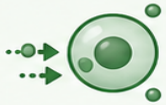
Design Strategy: Mimicking the Intrinsic Regeneration Cascade

PP: Poly(organophosphazene)-polyethyleneimine

1 Injectable platform

Thermosensitive PP hydrogel

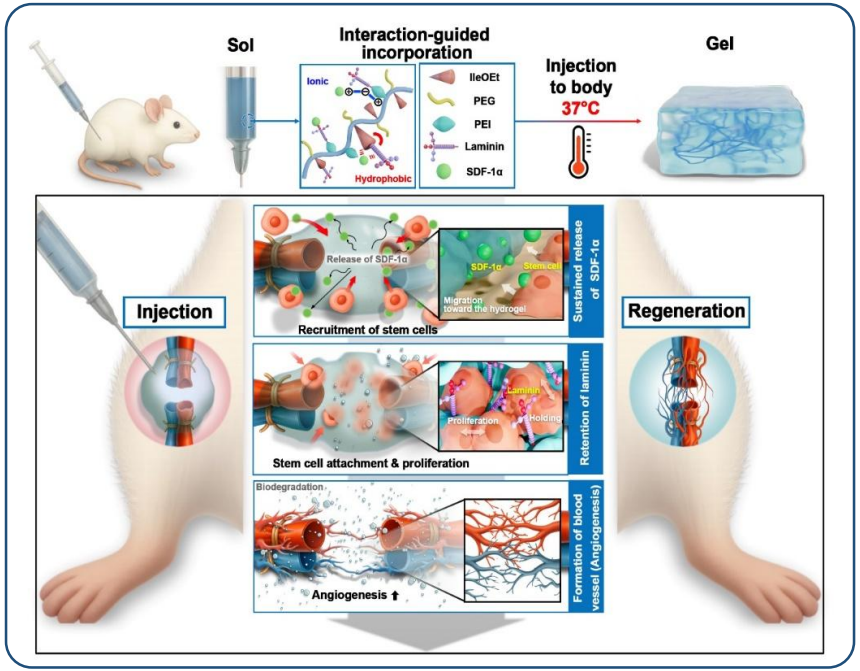
2 Dual regenerative cues



SDF-1α (S) and Laminin (L)

3 Expected outcome

Angiogenesis and tissue regeneration

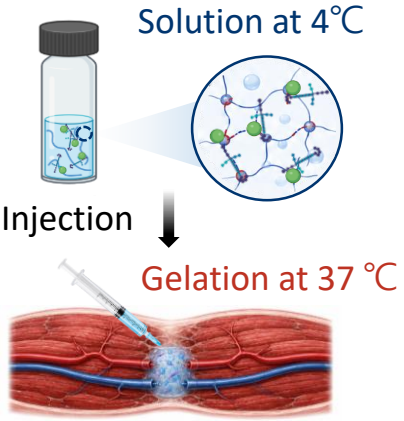


➡ This system combines cell recruitment and matrix-guided support in a single injectable platform

Thermosensitive PP Hydrogel Forms an Injectable Local Depot

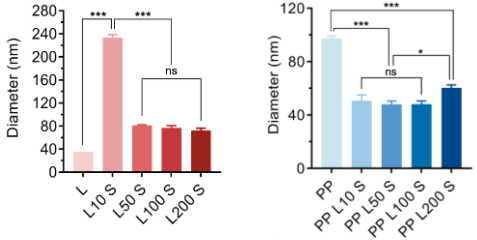
PPL: PP and L complex
PPLS: PP, L, and S complex

Injectable & Thermosensitive

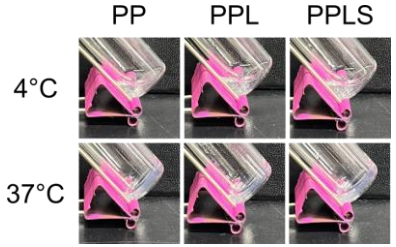


In situ gel formation and local retention

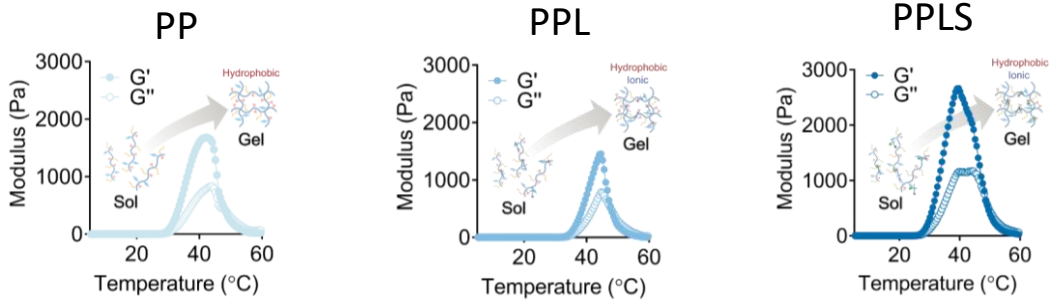
A Nanocomplex formation



B Sol-gel transition



C Thermosensitive rheology

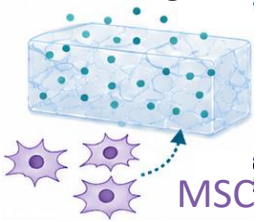


Body-temperature gelation creates a local depot for regenerative cues

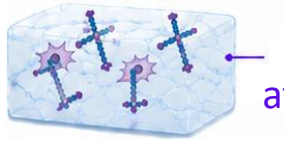
Sustained SDF-1α Release and Laminin Retention Support MSC Recruitment

Concept

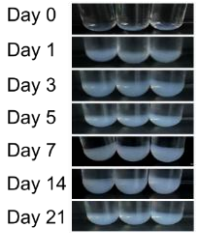
1. Sustained release of SDF-1α

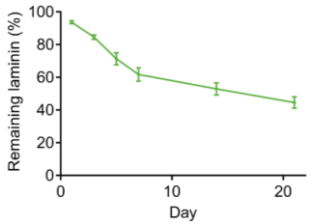


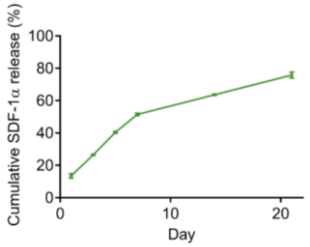
2. Laminin retention



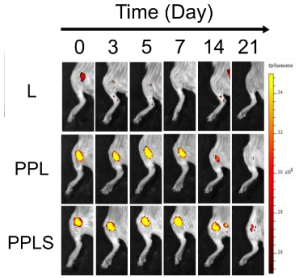
A Dual-cue retention and release profile

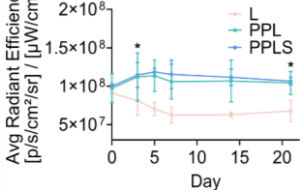


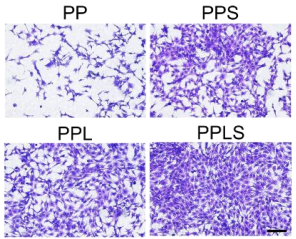


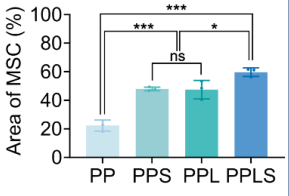


B In vivo laminin retention and MSC recruitment





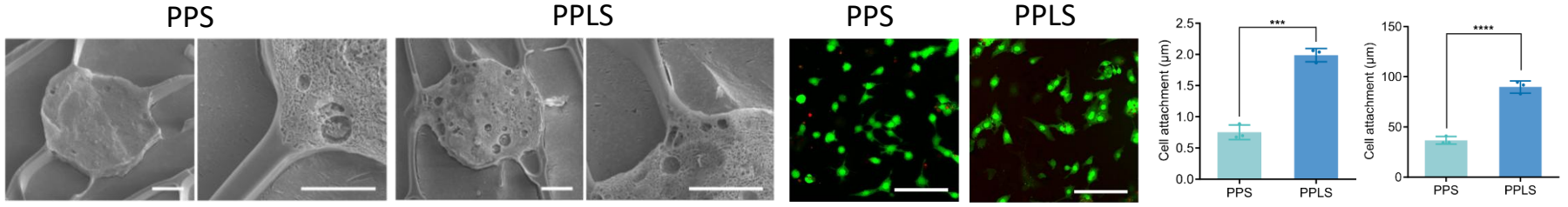




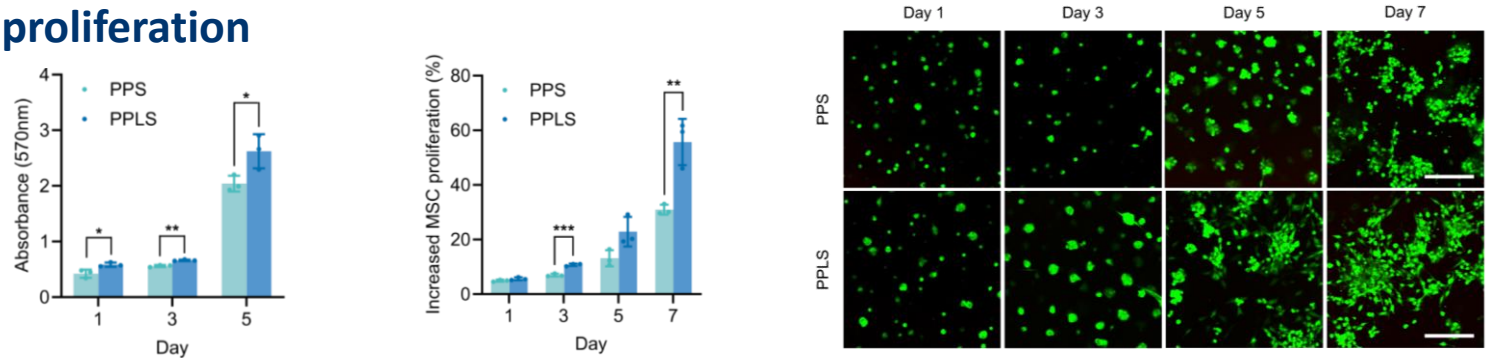
PPLS enables sustained SDF-1α release and prolonged laminin retention

Laminin Retention Enhances Cell Attachment and Proliferation

A Cell attachment



B Cell proliferation

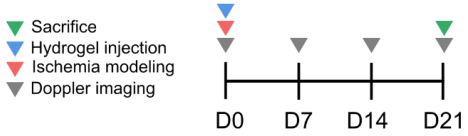


Laminin-retaining PPLS supports MSC adhesion and growth

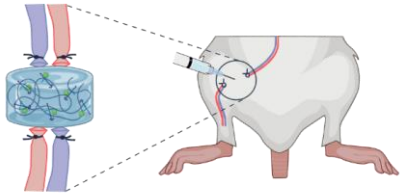
In Vivo Hindlimb Ischemia: Improved Perfusion and Angiogenesis

Study design

Timeline

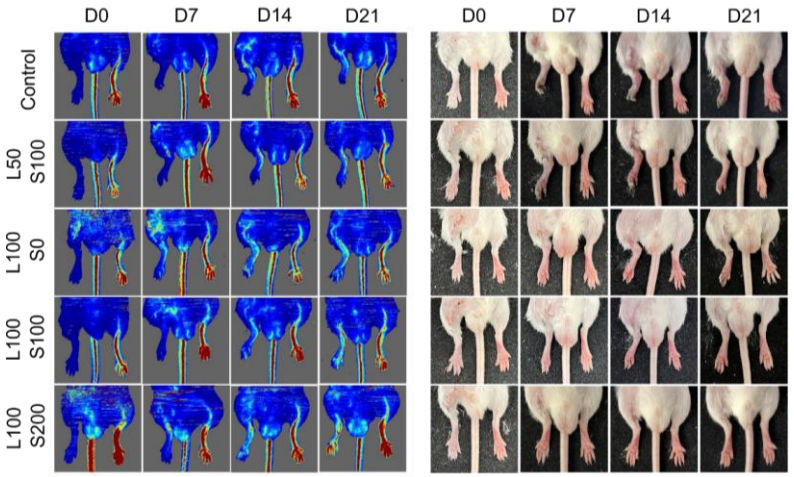


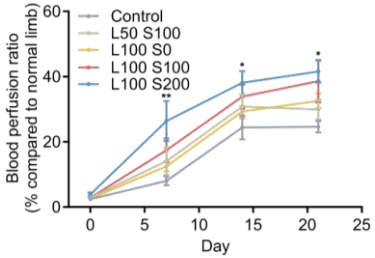
Injection schematic

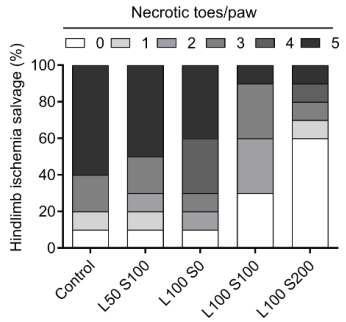


In situ hydrogel injection into ischemic hindlimb

A Perfusion recovery



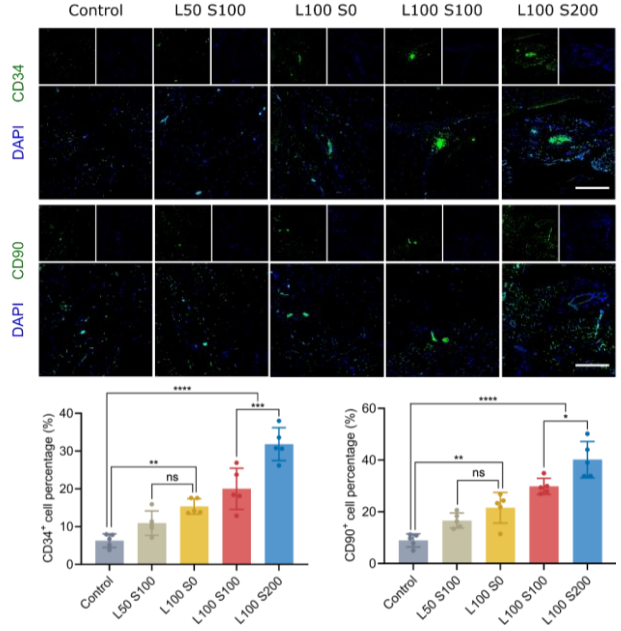




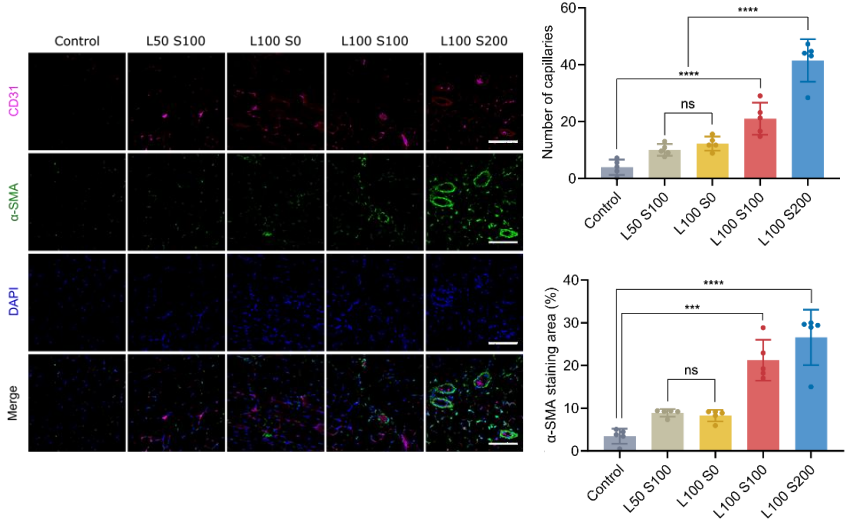
PPLS improved limb perfusion and reduced ischemic damage *in vivo*

Regenerative Cell Recruitment and Angiogenesis

A Regenerative cell recruitment



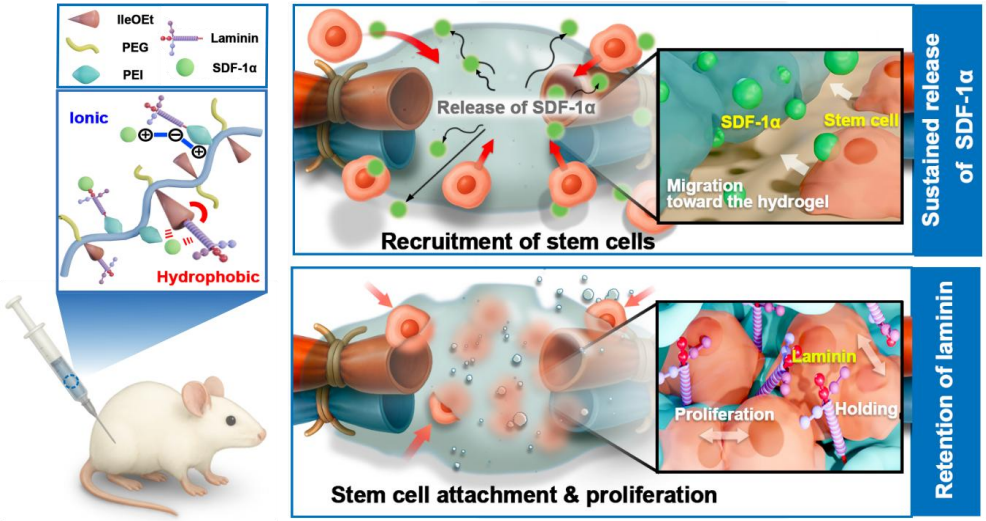
B Angiogenesis and vessel maturation



PPLS drives regenerative recruitment, angiogenesis, and vessel maturation

Conclusion

An Injectable Hydrogel Niche Mimicking intrinsic Regeneration



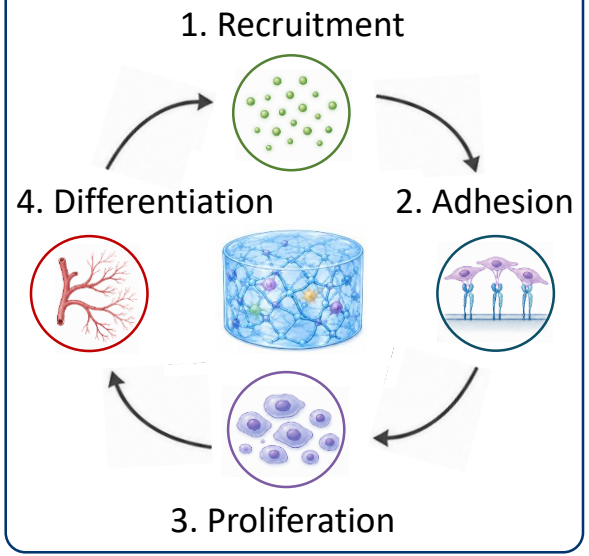
SDF-1α-driven
stem cell recruitment

Laminin-mediated
cell attachment and prolifertion

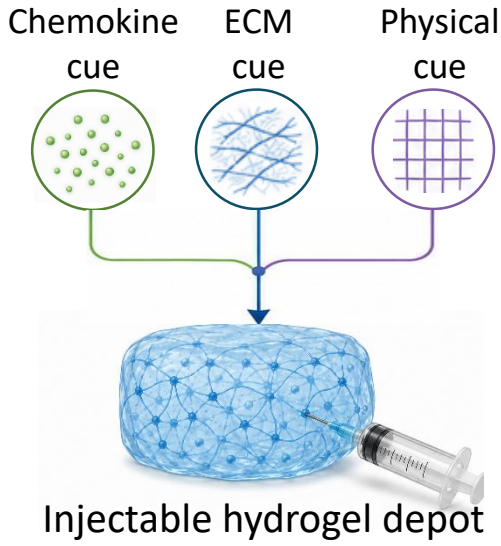
Enhanced
angiogenesis and perfusion recovery

Regenerative Cell Recruitment and Angiogenesis

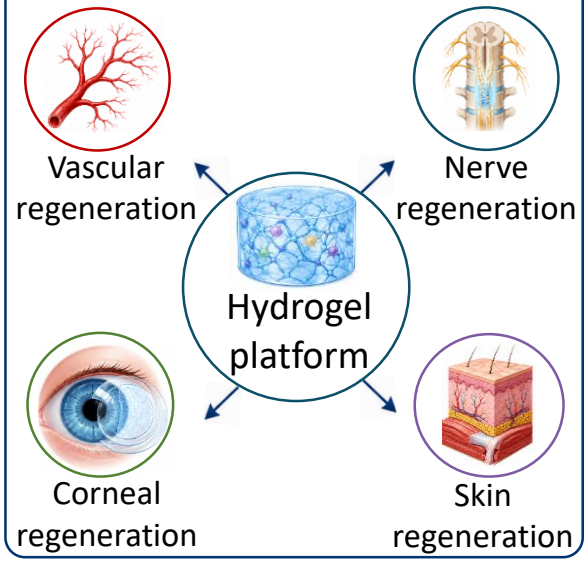
1. Cascade-mimicking design



2. Programmable bioactive cues



3. Versatile regenerative platform



A versatile hydrogel platform for intrinsic tissue repair

Acknowledgements

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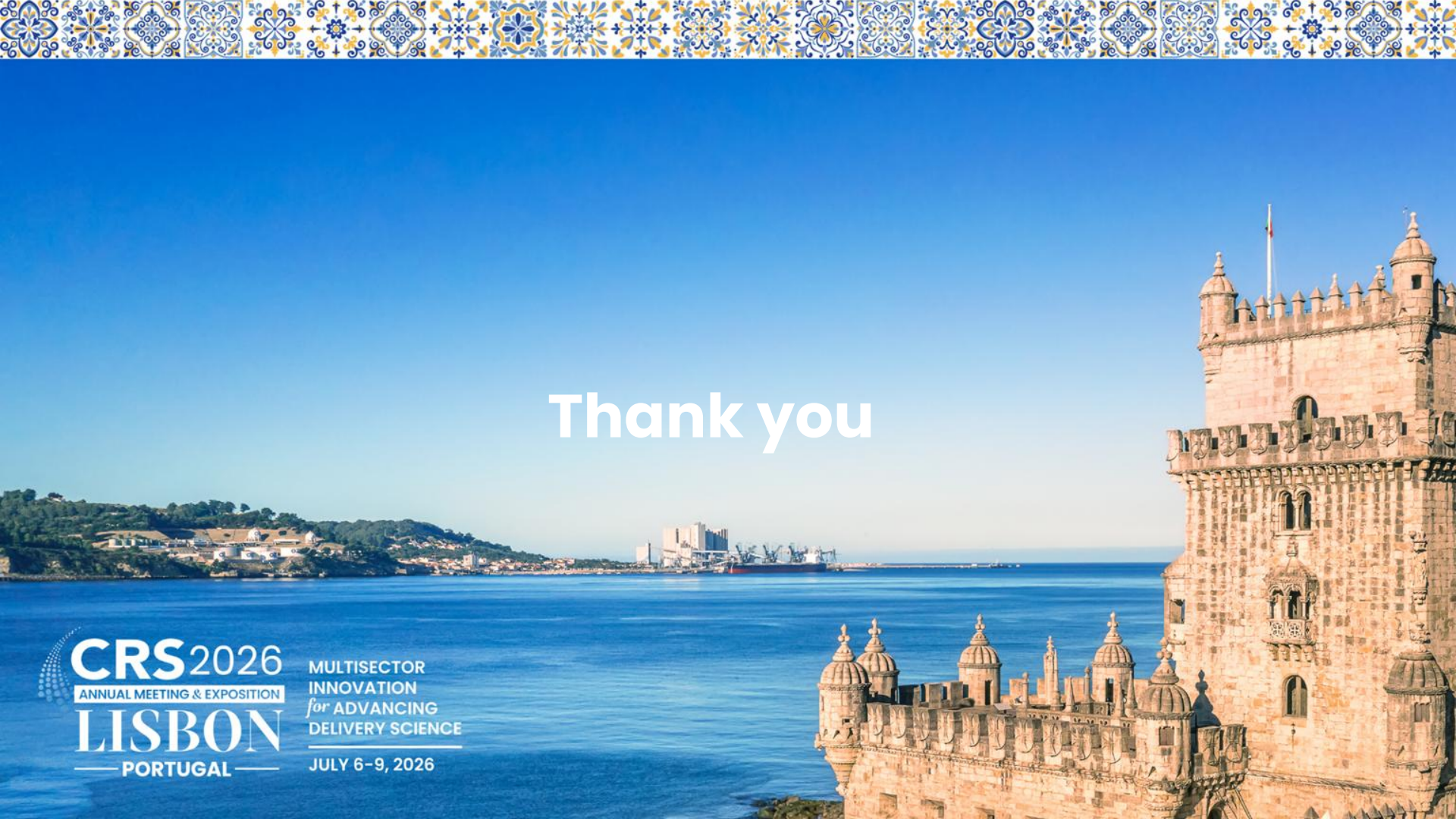
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