Ulta-Fine 3D Bioprinting of Dynamic Hyaluronic Acid Hydrogel for in Vitro Modeling

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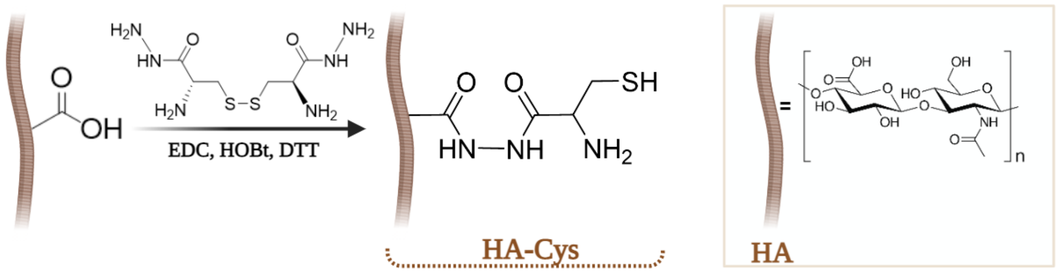
1 OVERVIEW

Aim of the study: to design Hyaluronic acid (HA)-based bioink using dynamic disulfide-crosslinking at physiological pH by modifiying HA with cysteine moities.

Problem: Slow gelation time limits practical application.

Solution: Using potassiuim iodide (KI) as a novel catalyst to accelerate gelation.

2 Synthesis of Cysteine-modified HA



Thiol oxidation without KI

$R\text{-}SH \rightleftharpoons R\text{-}S^- + H^+$

$2R\text{-}S^- + O_2 \rightarrow R\text{-}S\text{-}S\text{-}R + O_2^-$

Thiol oxidation WITH KI

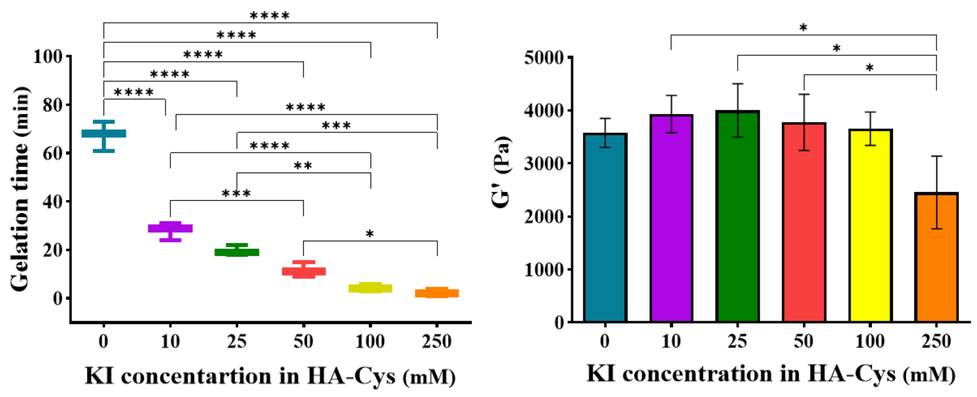
$4KI + O_2 \rightarrow 2K_2O + 2I_2$

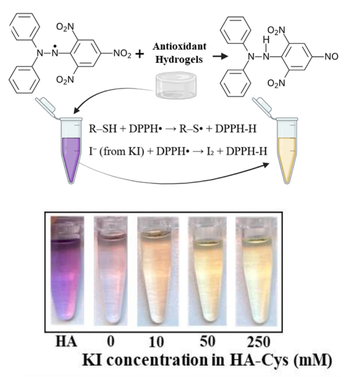
$RS^- + I_2 \rightarrow R\text{-}SI + I^-$

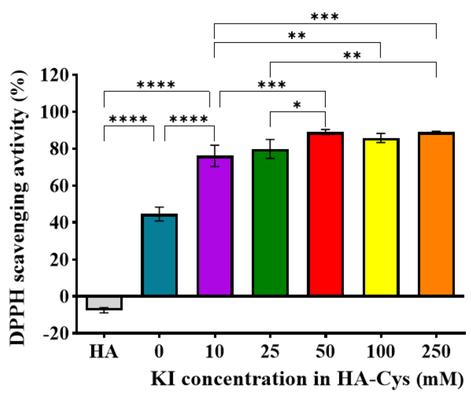
$RS^- + R\text{-}SI \rightarrow R\text{-}S\text{-}S\text{-}R + I^-$

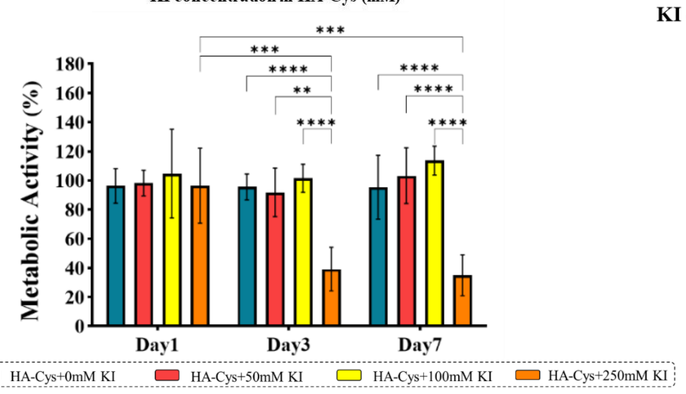
$I_2 + I^- \rightarrow I_3^-$

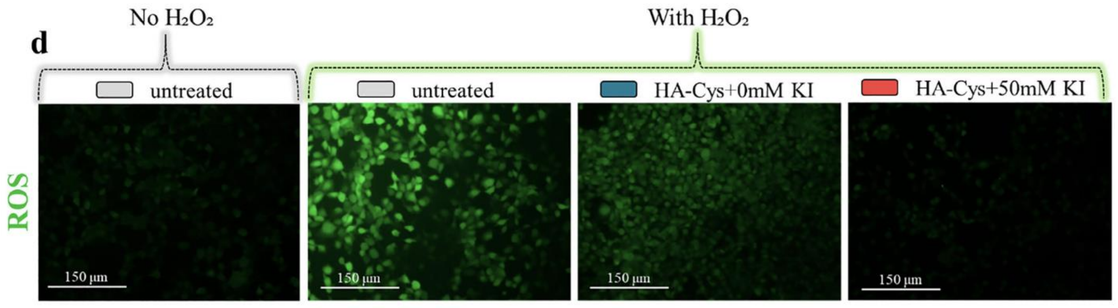
3 Advantages of using KI











4 3D Bioprinting

Biocompatibility After Injection



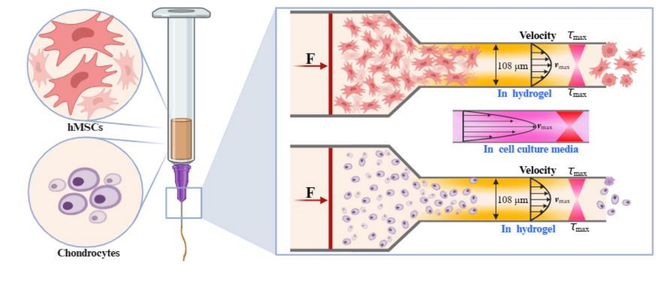


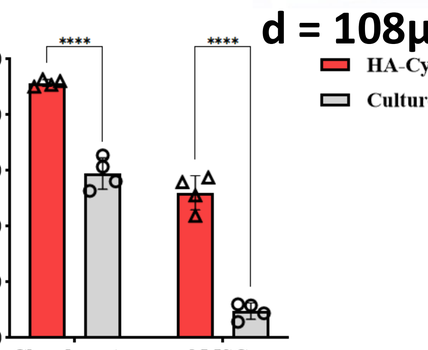


d = 108μm G32



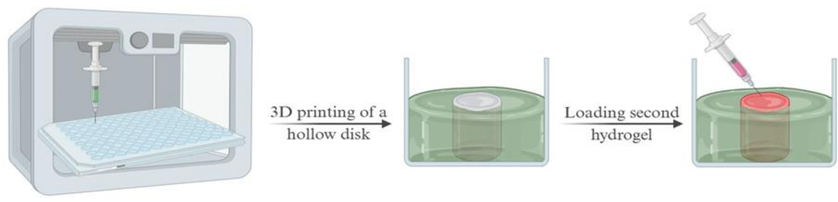


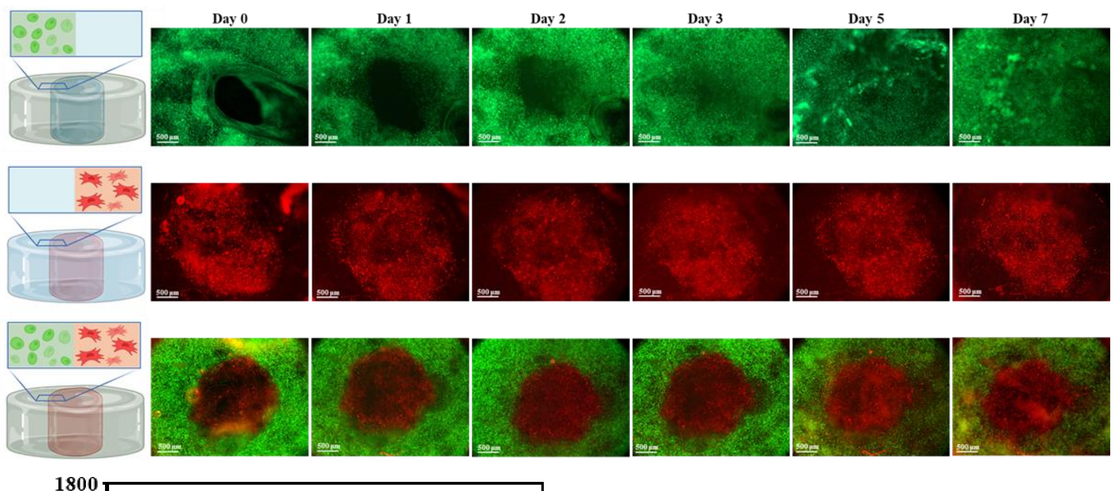


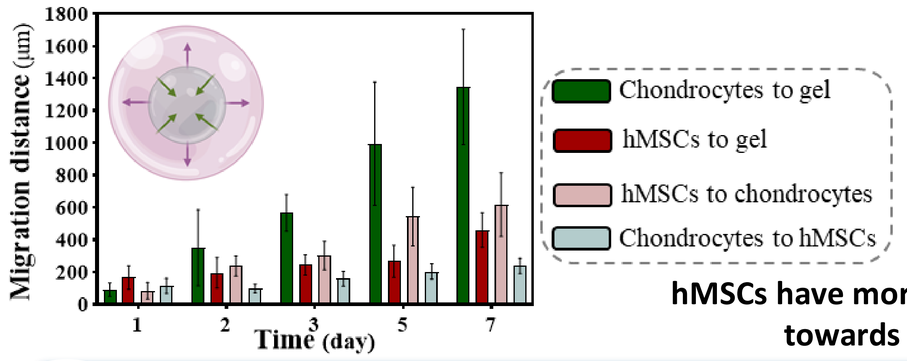


50% sized of a simplified human ear

Co-culture Model







hMSCs have more migratory potential towards chondrocytes

5 Conclusion

We developed ECM-mimetic bioink using cysteine-modified HA with KI to control gelation and improve printability. This results underscores the importance of optimizing gelation kinetics and crosslinking mechanisms to enable 3D printing of complex models with ultra-fine needles.

The hydrogel supports tunable degradation and multi-cell encapsulation, enabling advanced 3D disease modeling and tissue engineering.

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Acknowledgements

MARIE CURIE ACTIONS

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