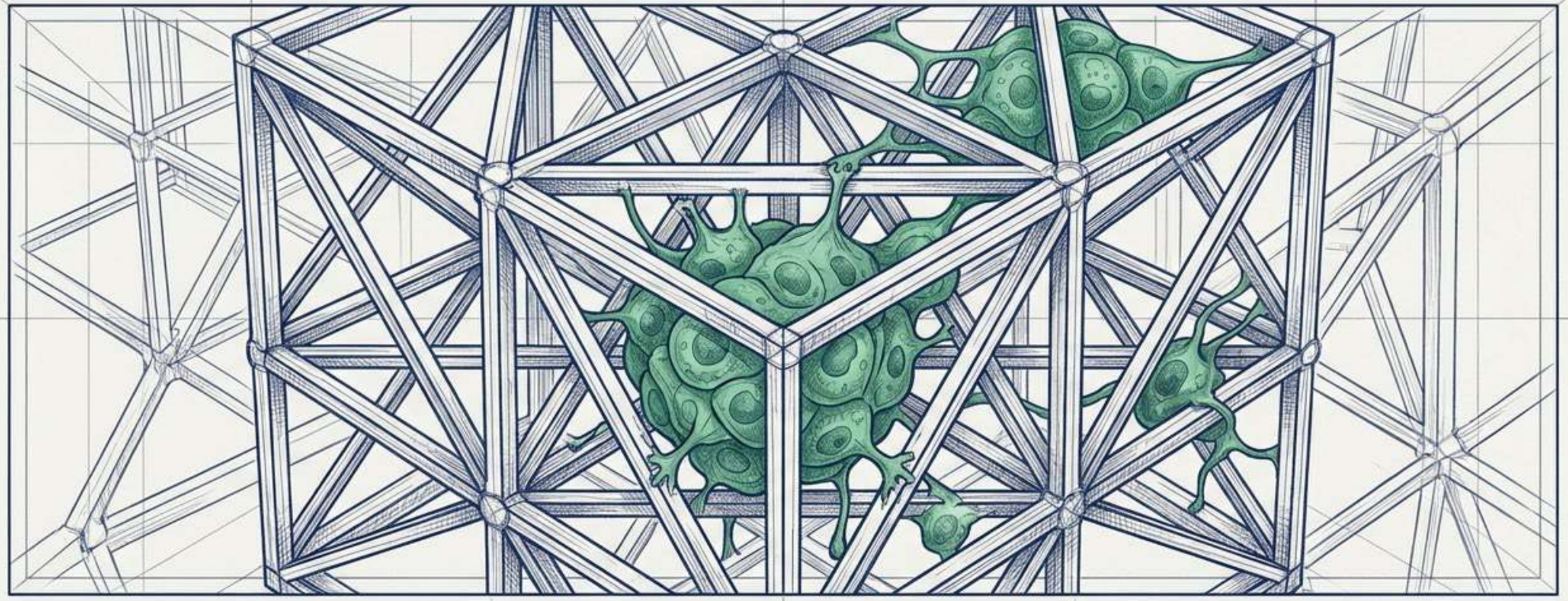
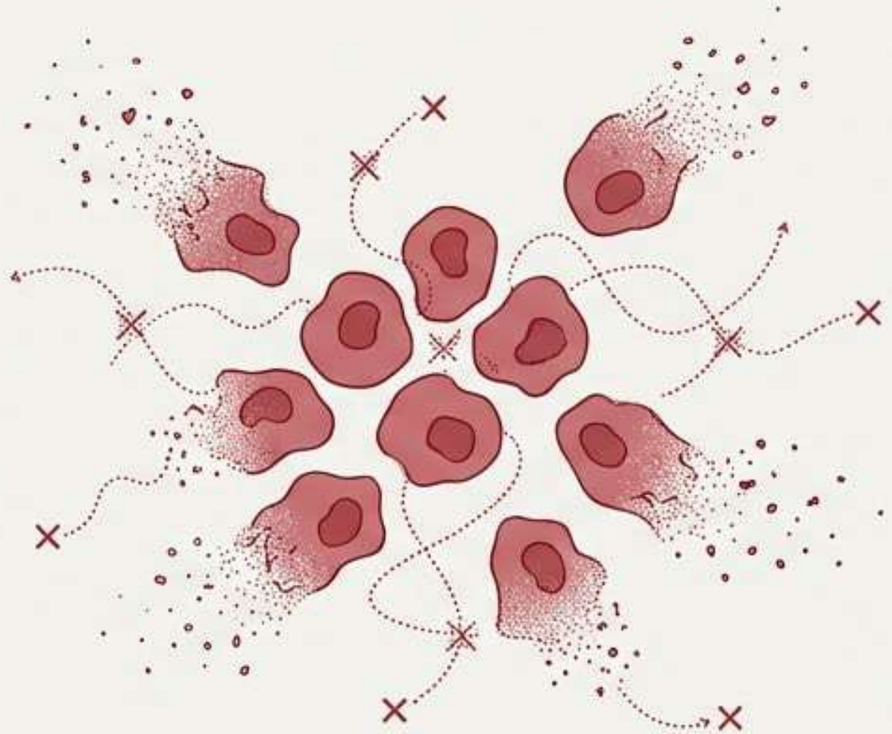


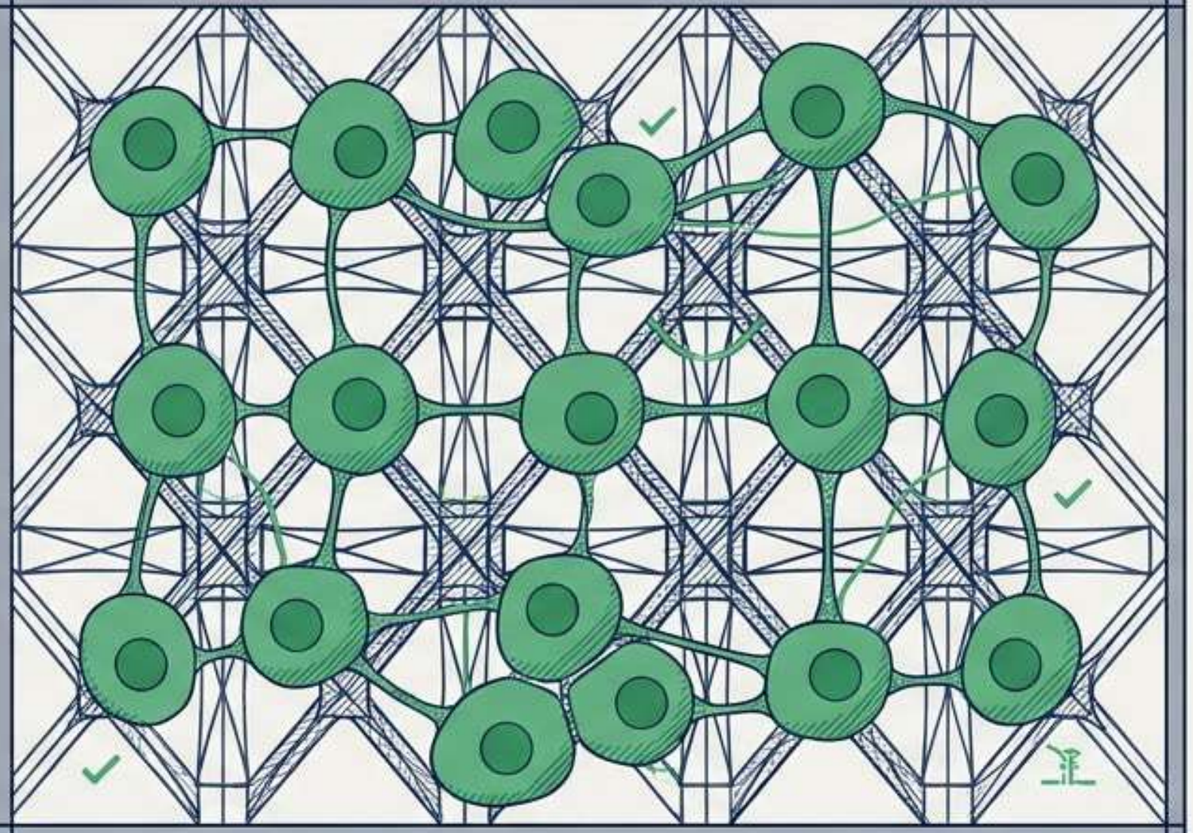
The Architecture of Regeneration

Harnessing Kidney dECM Hydrogels for Cell Delivery and Tissue Engineering

Naked Cells Injecting into Host



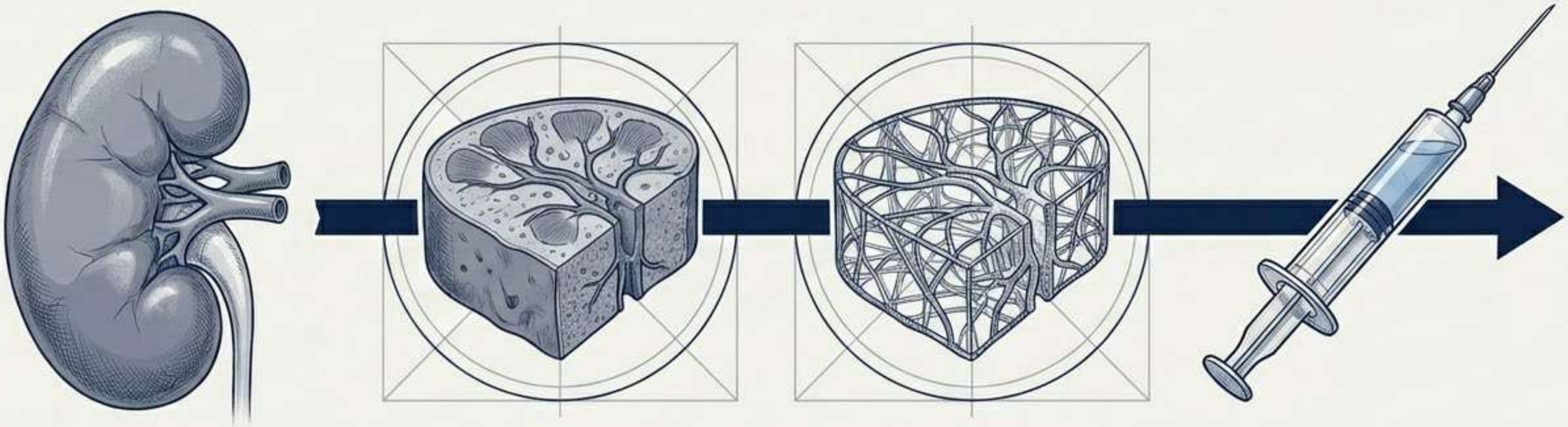
Cells Anchored in Matrix



The Scaffold is as Vital as the Cell

In regenerative medicine, injecting raw, unsupported cells directly into host tissue yields poor viability. Cells disperse, fail to anchor, and die.

To survive, differentiate, and execute paracrine/autocrine functions, cells require their native structural framework—the Extracellular Matrix (ECM). We must engineer a delivery device that mimics this biological architecture.



1. Porcine Kidney Harvest

2. Tissue Isolation

3. Decellularization & dECM Skeleton

4. Engineered dECM Hydrogel

The Solution: Porcine dECM Hydrogels

By harvesting porcine kidney tissue and stripping away immune-triggering cellular material, we isolate the fundamental protein skeleton.

This Decellularized Extracellular Matrix (dECM) is then engineered into a thermosensitive hydrogel—a smart injectable vehicle customized for localized cell delivery.

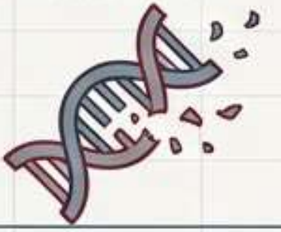
Manufacturing the Blueprint: The Decellularization Protocol

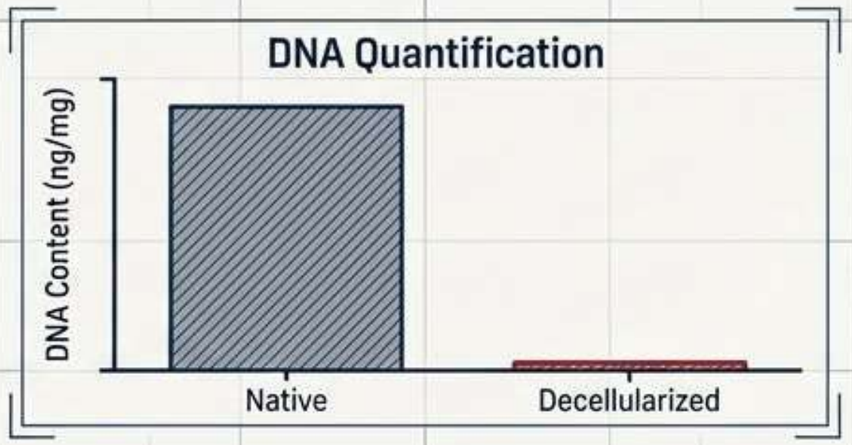
1 SDS Detergent (1%)
Continuous wash for 3-5 days

2 Triton X-100
2 cycles spanning 7 days total

3 PBS Wash
7 days to eliminate all residual detergents

4 DNase Treatment
Overnight digestion of residual DNA



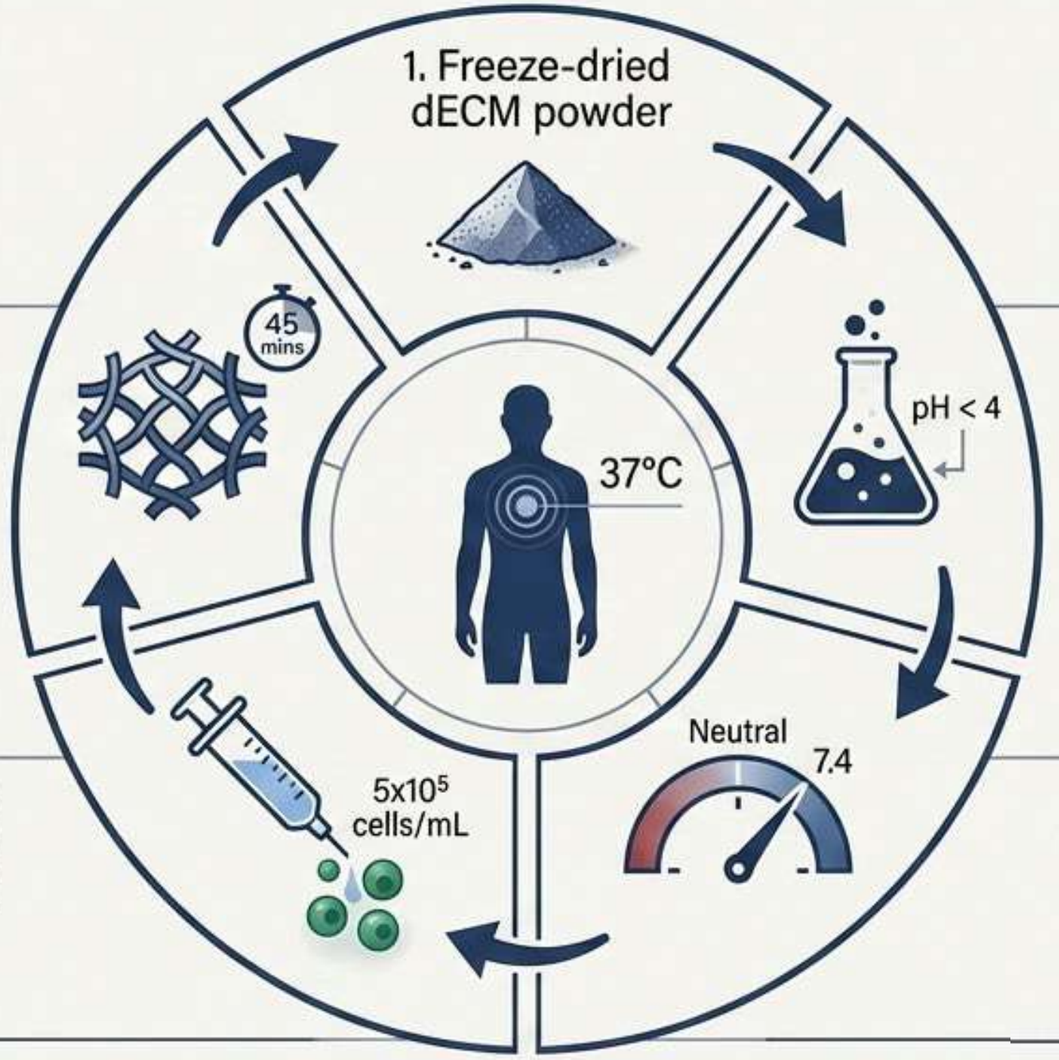


Insight Box

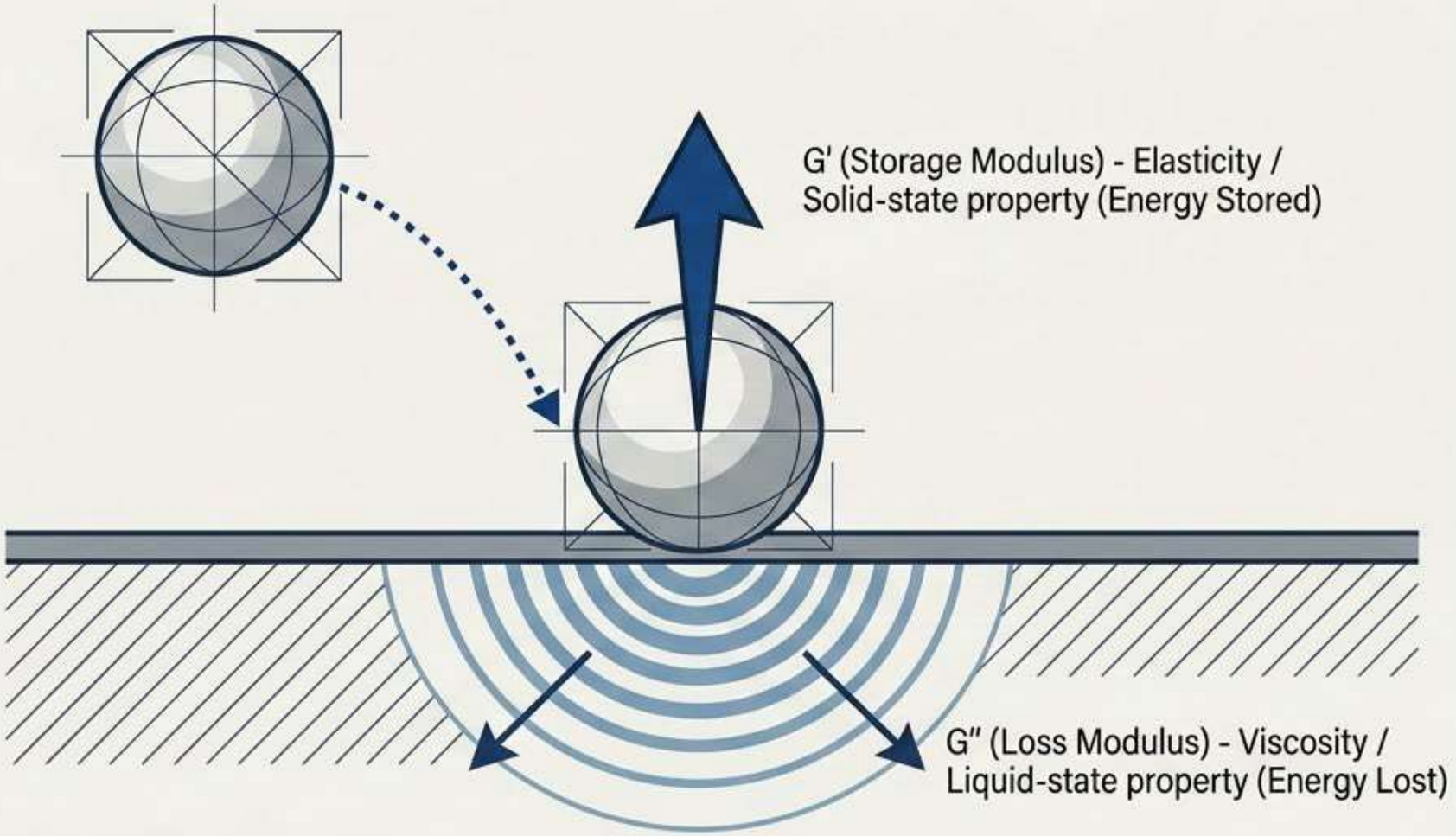
The process ruthlessly eliminates cell nuclei and DNA to prevent immune rejection. While some ECM proteins are inevitably lost, the vital structural architecture—Collagen and Glycosaminoglycans (GAGs)—is successfully preserved.

From Powder to Injectable Matrix

The matrix is engineered for surgical practicality. It remains a fluid solution at room temperature for seamless injection, automatically polymerizing into a stable hydrogel assembly only when exposed to core body temperature (37°C).



Viscoelasticity: The Bouncing Ball Metaphor



Hydrogels are neither pure solid nor pure liquid.

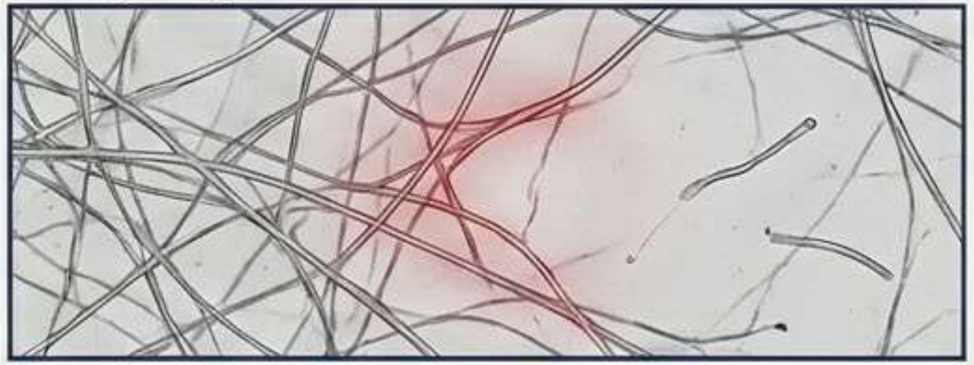
To ensure the gel is fluid enough to inject but solid enough to anchor cells, we measure its rheological balance.

Testing at 1% strain and 1 Hz frequency confirms the dECM hydrogel maintains a highly stable, linear viscoelastic range capable of withstanding physical stress without fracturing.

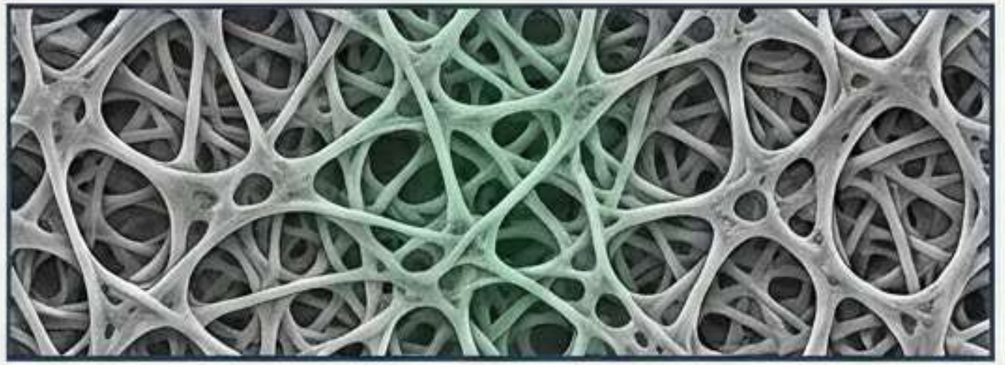
Physical Superiority: dECM vs. Collagen Type 1

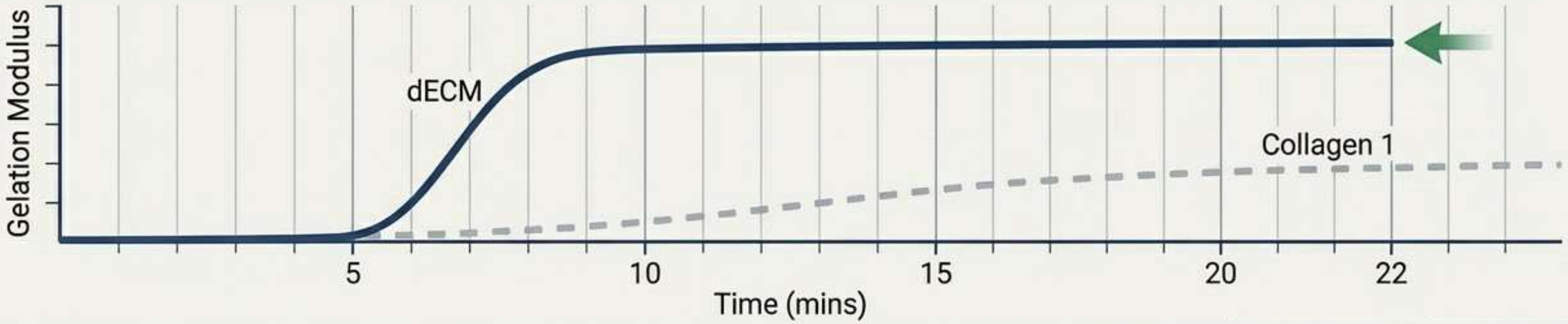
dECM forms a drastically more complex architectural structure than pure Collagen 1. Crucially, it responds faster to thermal shifts, achieving a complete, stable cross-link more rapidly once injection occurs.

Collagen Type 1

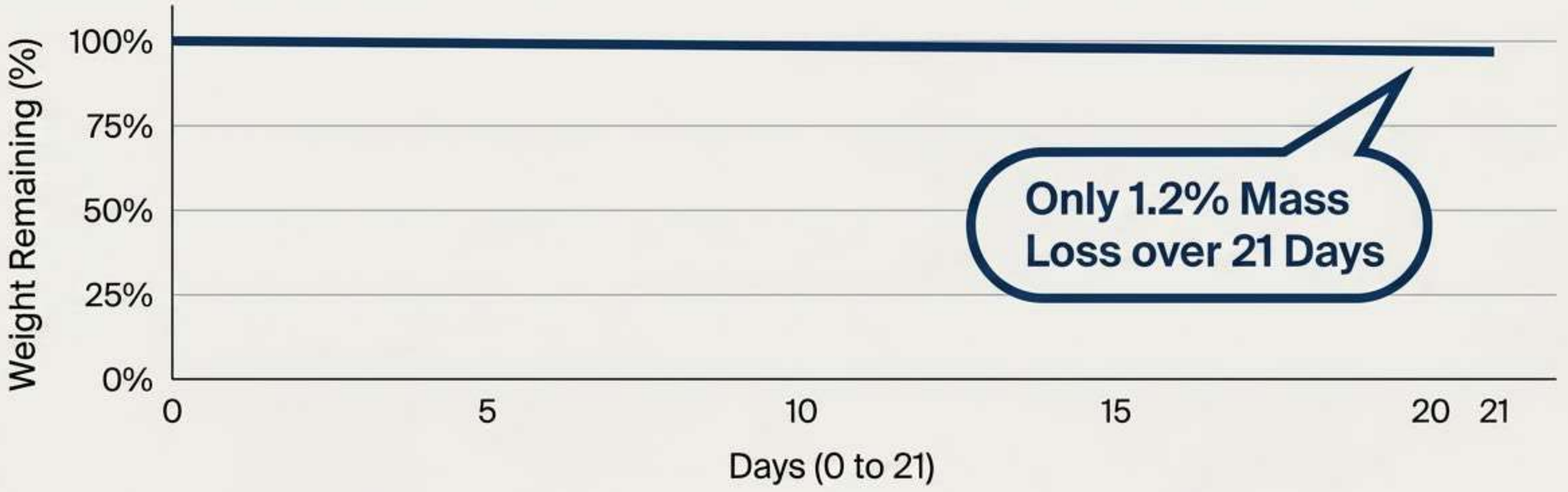


dECM





Biodegradation & Environmental Stability



A successful scaffold must be entirely biodegradable, but it must not collapse prematurely.

Insight: The dECM hydrogel exhibits exceptional structural persistence. It degrades slowly enough to support cell proliferation, eventually making way for newly regenerated natural tissue.

Biological Validation I: Cell Survival & Proliferation

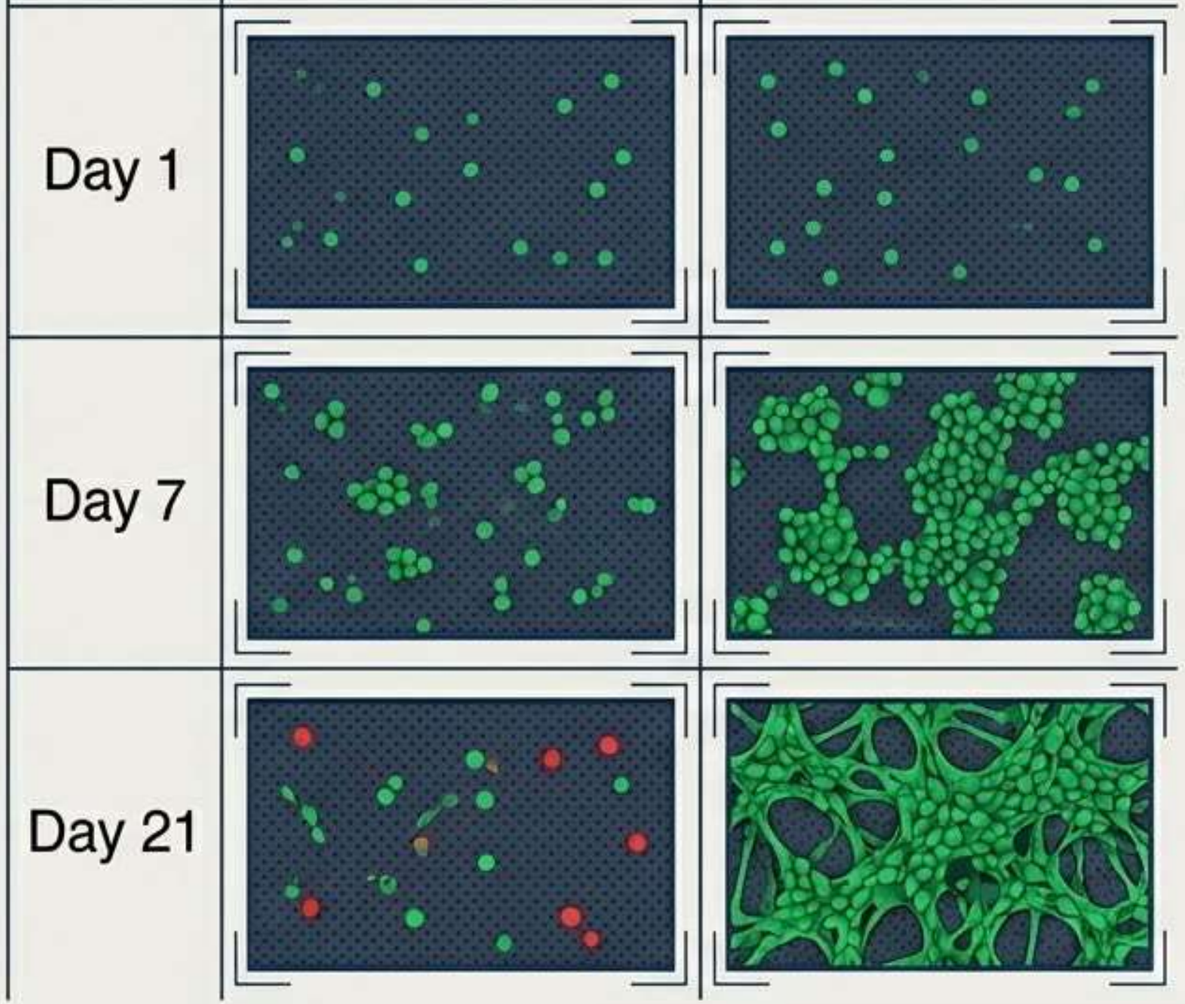
Encapsulating human Adipose-Derived Stem Cells (ADSC) and Human Kidney Proximal Tubule cells (HK-2).

Results:

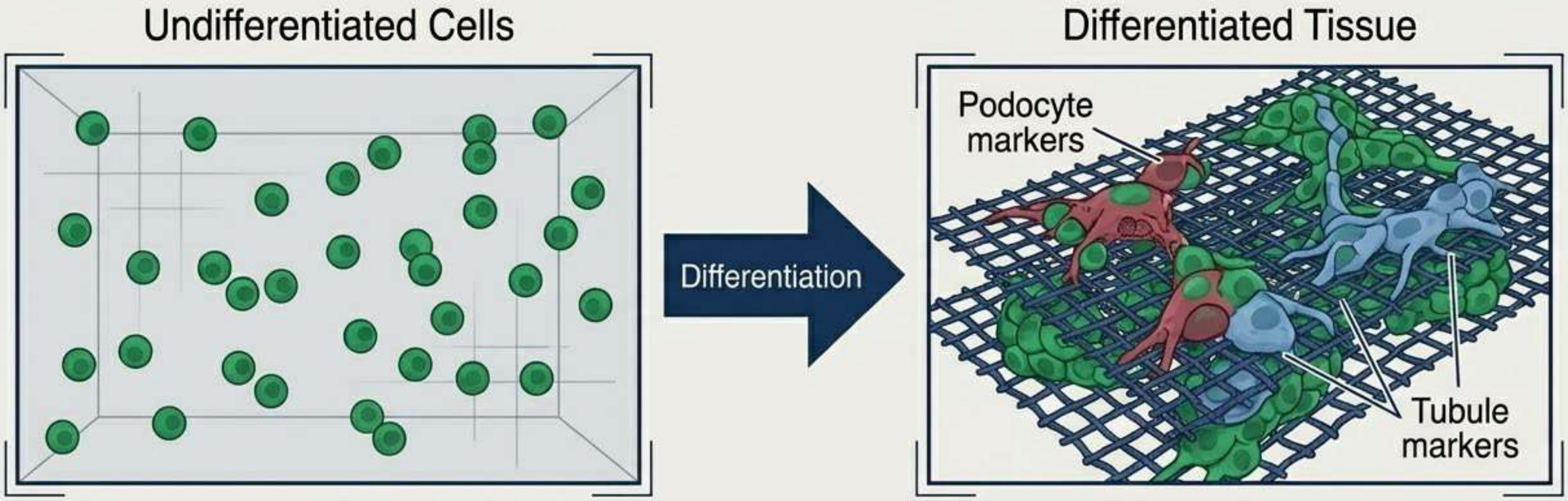
Zero early cell death on Day 1.

By Days 7 and 21, cells thrive.

HK-2 cells grow far more robustly and completely inside the dECM architecture architecture compared to a standard collagen environment.



Biological Validation II: Directing Differentiation



The hydrogel doesn't just keep cells alive; it tells them what to do.

Insight: HK-2 cells encapsulated in dECM show significantly higher, accelerated expression of podocyte and tubule differentiation markers compared to standard collagen. The matrix actively guides tissue regeneration.

The Diagnostic Matrix: Why dECM Wins

dECM outperforms pure cell injection and standardized collagen across every critical biomechanical and biological dimension.

	Pure Naked Cells	Collagen Type 1	dECM Hydrogel
Injectable Delivery	Yes ✚	Yes ✚	Yes ✚
Structural Complexity	None ▬	Low ▬	High ✚
Fast Thermal Gelation	N/A ▬	Moderate ▬	Superior ✚
Long-Term Cell Viability	Low ▬	High ✚	High ✚
Active Differentiation Signaling	None ▬	Low ▬	High ✚

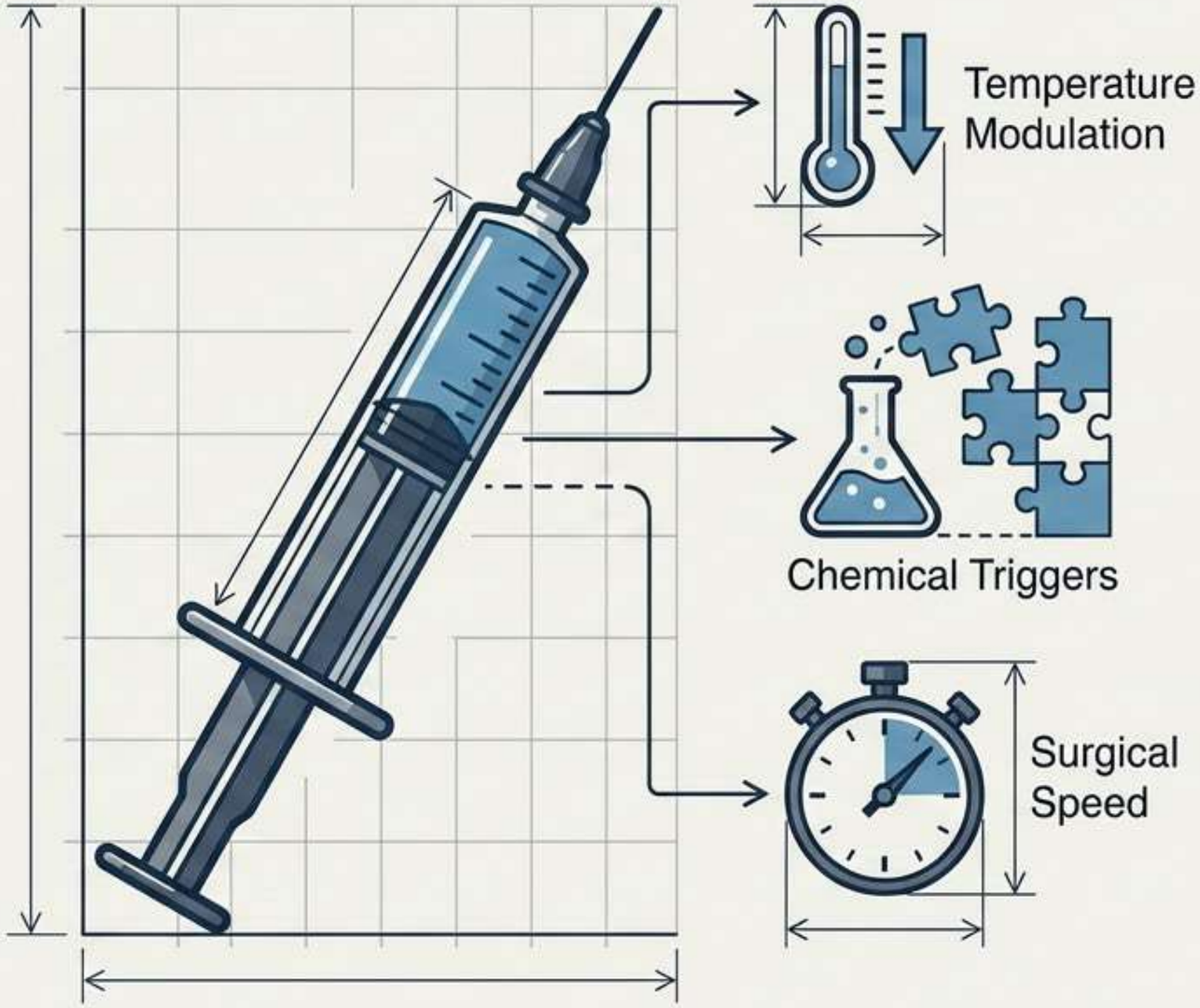
Clinical Horizons: The Operating Room Challenge

Goal: Bridging the gap between laboratory perfection and surgical practicality

Current challenge: Polymerization at 37°C takes 45 minutes—too slow for an active surgical theater.

1. **Temperature Modulation:** Engineering the transition temperature down to 25°C or 15°C for rapid gelation upon injection.

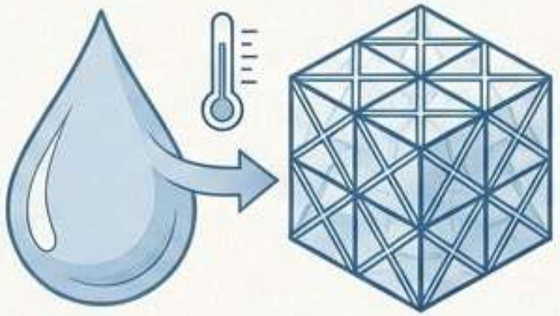
2. **Chemical Triggers:** Integrating agents like Alginate to trigger immediate, instantaneous cross-linking when mixed on-site.



Summary & Clinical Trajectory

Smart Scaffold

dECM successfully strips immune-triggers while preserving the complex architectural proteins (Collagen/GAGs) necessary for cell life.



Thermo-Responsive Delivery

Exists as a highly injectable liquid at room temperature, self-assembling into a robust solid mesh at body temperature.

Pro-Regeneration

Vastly outperforms pure collagen in driving human kidney cell survival and differentiation. The premier candidate for future Chronic Kidney Disease (CKD) therapies.