

# Preclinical Evaluation of a 3D-Printed Porcine-Derived ECM Scaffold Loaded with Gentamicin in a Rabbit Tendon Defect Model

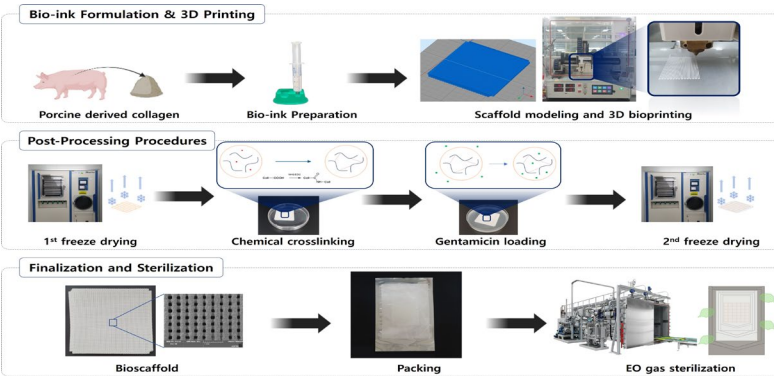
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## Background

- Tendon defects ▶ poor healing & high infection risk
- Conventional ECM ▶ weak structure & no antibiotic delivery
- Need for scaffold with both structural support and infection control

## Schematic illustration of the 3D scaffold

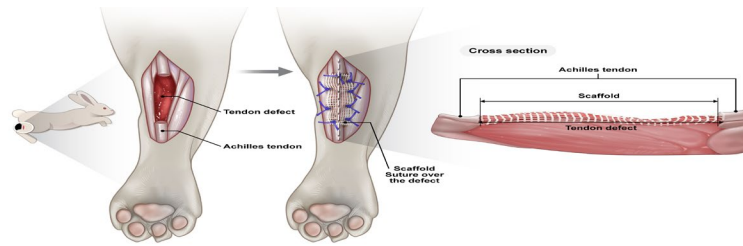


## Hypothesis

We hypothesized that this scaffold improves healing and prevents infection.

## Study design

- Rabbit Achilles defect (2×1 cm)
- 3 groups: Control ECM vs 3D scaffold vs 3D + Gentamicin
- n=60 / 1–12 weeks follow-up

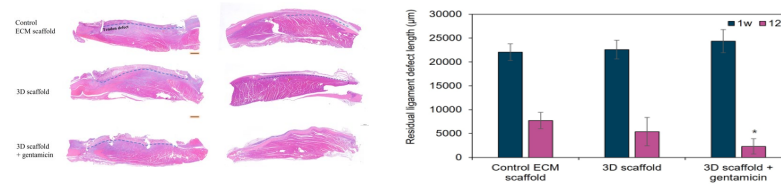


## Evaluation

- Defect length
- Collagen (Masson)
- PCNA (proliferation)
- CD31 (angiogenesis)

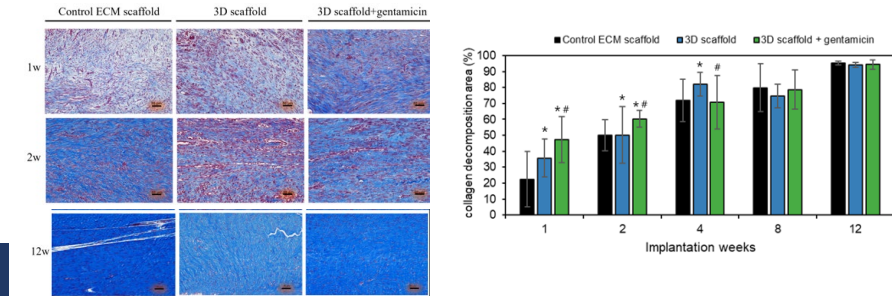
### Result 1. Tendon healing outcome

- Progressive healing observed in all groups over time
- **3D + gentamicin group showed the greatest defect reduction**
- Significantly smaller residual defect at 12 weeks
- (2,301 vs 7,738 vs 11,846 μm)



### Result 2. Collagen Deposition & Scaffold Integrity

- Early phase **showed increased collagen deposition** in gentamicin group (60.37 vs 50.09, p<0.001)
- **Delayed scaffold degradation** compared to control (28.67 vs 6.87 mm<sup>2</sup>, p=0.008)
- Maintained scaffold structure supported organized tissue remodeling



### Result 3. Cellular Proliferation (PCNA)

- Markedly increased PCNA expression at early stage (1 week)
- (11.39 vs 3.07, p<0.001)
- Indicates **enhanced early cellular activity**

### Result 4. Angiogenesis (CD31)

- Increased CD31-positive vessel formation at 4 weeks
- (12.40 ± 3.98 vs lower in control, p<0.01)
- More robust vascularization in scaffold groups

	Period <sup>†</sup>	Group <sup>‡</sup>	Mean ± SD <sup>‡</sup>	p-value <sup>†‡</sup> (vs. Control ECM scaffold) <sup>†</sup>	p-value <sup>†‡</sup> (vs. 3D scaffold) <sup>‡</sup>	p-value <sup>†‡</sup> (vs. 3D scaffold + gentamicin) <sup>‡</sup>
PCNA (%) <sup>‡</sup>	1w <sup>†</sup>	Control ECM scaffold <sup>‡</sup>	3.07 ± 0.35 <sup>‡</sup>		0.002 * <sup>‡</sup>	0.000 * <sup>‡</sup>
	1w <sup>†</sup>	3D scaffold <sup>‡</sup>	8.31 ± 1.79 <sup>‡</sup>	0.002 * <sup>‡</sup>		0.014 * <sup>‡</sup>
	1w <sup>†</sup>	3D scaffold + gentamicin <sup>‡</sup>	11.39 ± 0.98 <sup>‡</sup>	0.000 * <sup>‡</sup>	0.041 * <sup>‡</sup>	
CD31 (%) <sup>‡</sup>	4w <sup>†</sup>	Control ECM scaffold <sup>‡</sup>	1.24 ± 1.10 <sup>‡</sup>		0.026 * <sup>‡</sup>	0.004 * <sup>‡</sup>
	4w <sup>†</sup>	3D scaffold <sup>‡</sup>	3.43 ± 1.43 <sup>‡</sup>	0.026 * <sup>‡</sup>		0.223 <sup>‡</sup>
	4w <sup>†</sup>	3D scaffold + gentamicin <sup>‡</sup>	4.71 ± 1.61 <sup>‡</sup>	0.004 * <sup>‡</sup>	0.223 <sup>‡</sup>	

## Conclusion

- Antibiotic-loaded scaffold improves tendon healing
- Provides both infection control and structural support
- Promising for **high-risk / infected wounds**