



Interest of type I collagen as an additive in an alginate-based bioink for the production of stratified cartilaginous substitutes by using 3D printing

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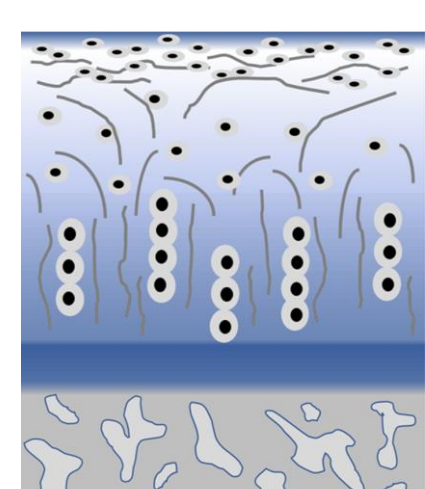
Interest of type I collagen as an additive in an alginate-based bioink for the production of stratified cartilaginous substitutes by using 3D printing

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Introduction

Hyaline cartilage



Stratified
Non vascularized
Non innervated

→ Limited self-repair properties

Trauma or overload

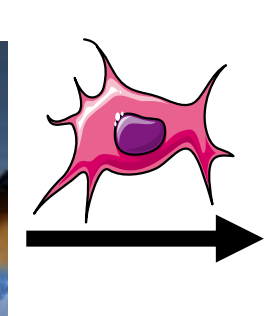


Focal lesions



No long-term surgical solution

Objectives

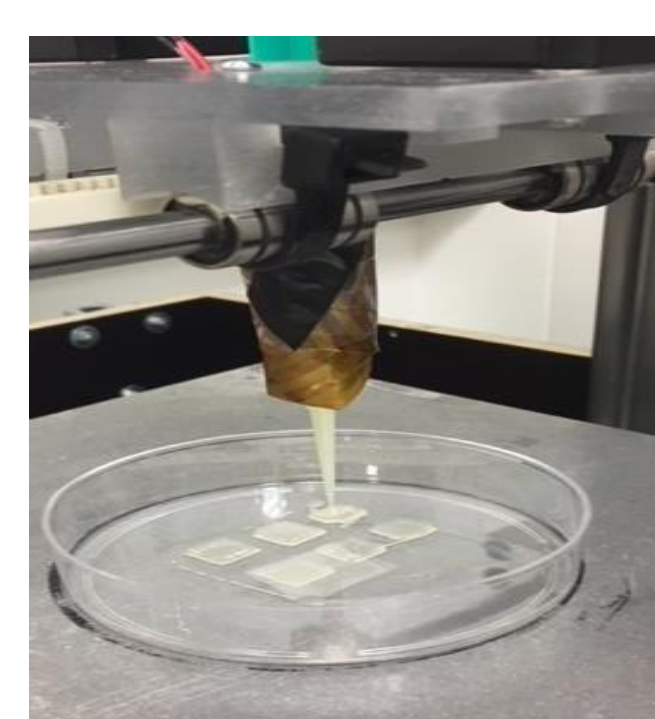


Mesenchymal stem cells

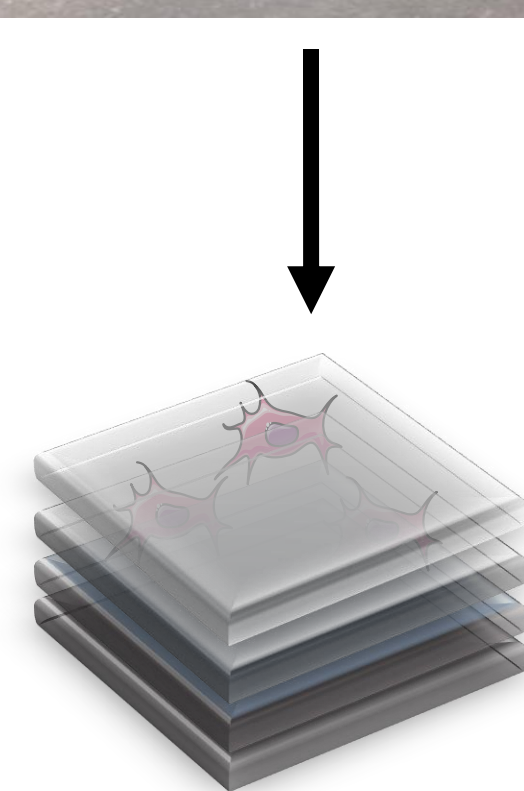
Alginate-based ink

Bioink

Extrusion-based 3D printing method

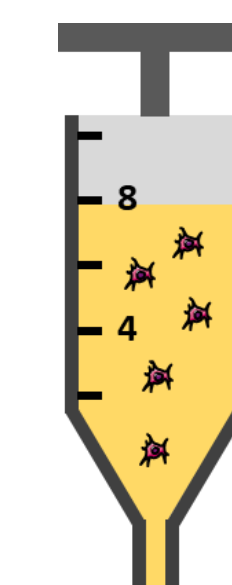


In vitro production of stratified cartilaginous substitutes



Methods

Cellularized bioink



Addition

Type I collagen



0, 0.5, 1 or 5 mg

To modulate the chondrogenic differentiation of MSCs

Culture conditions (56 days):

ITS 1%: Control

TGF-β1: Chondro-inductor

Analyses :

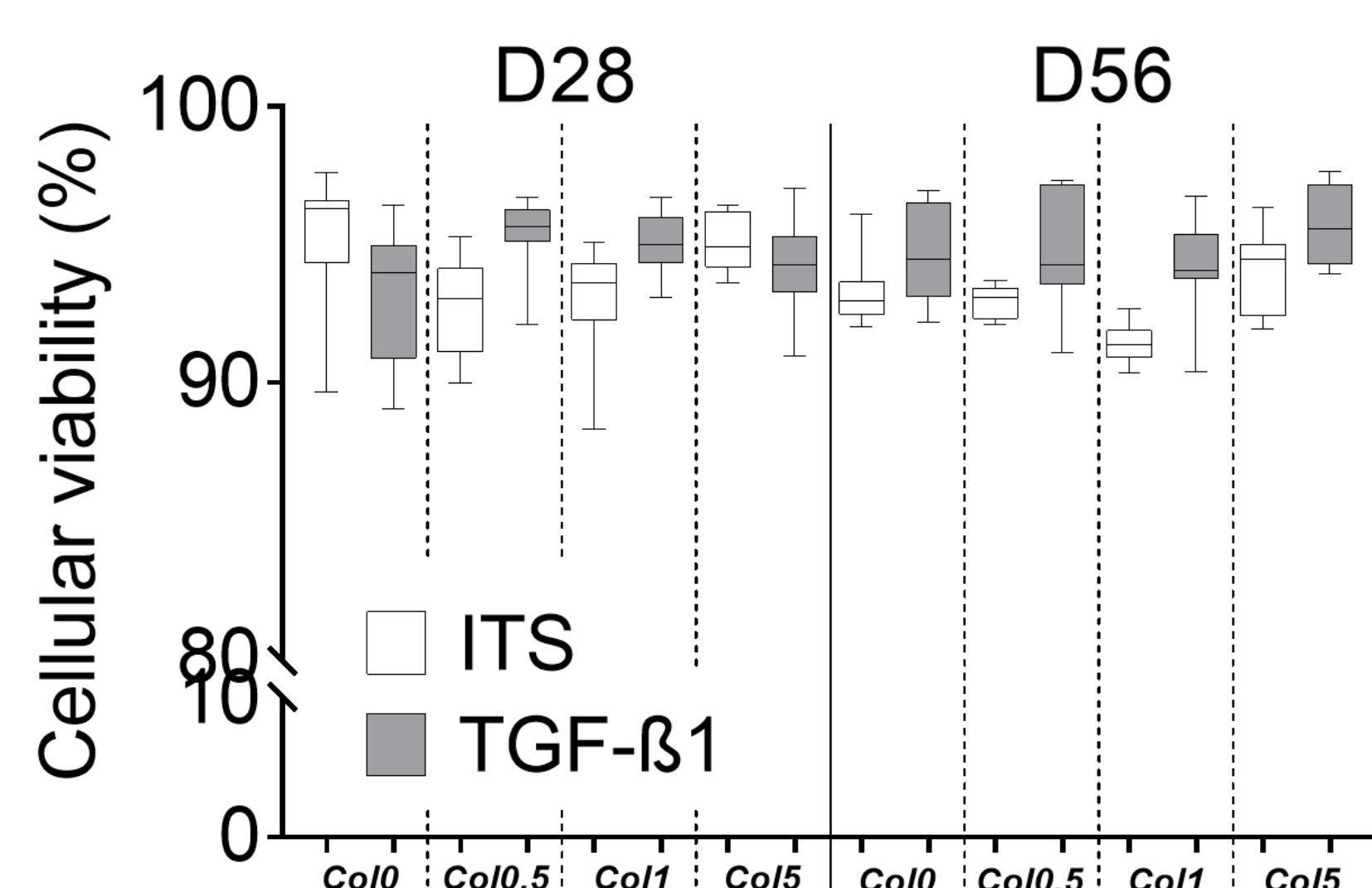
Cellular viability : LDH assay

Genes expressions : RT-qPCR

Matrix synthesis : Histological and immunohistochemical analyses

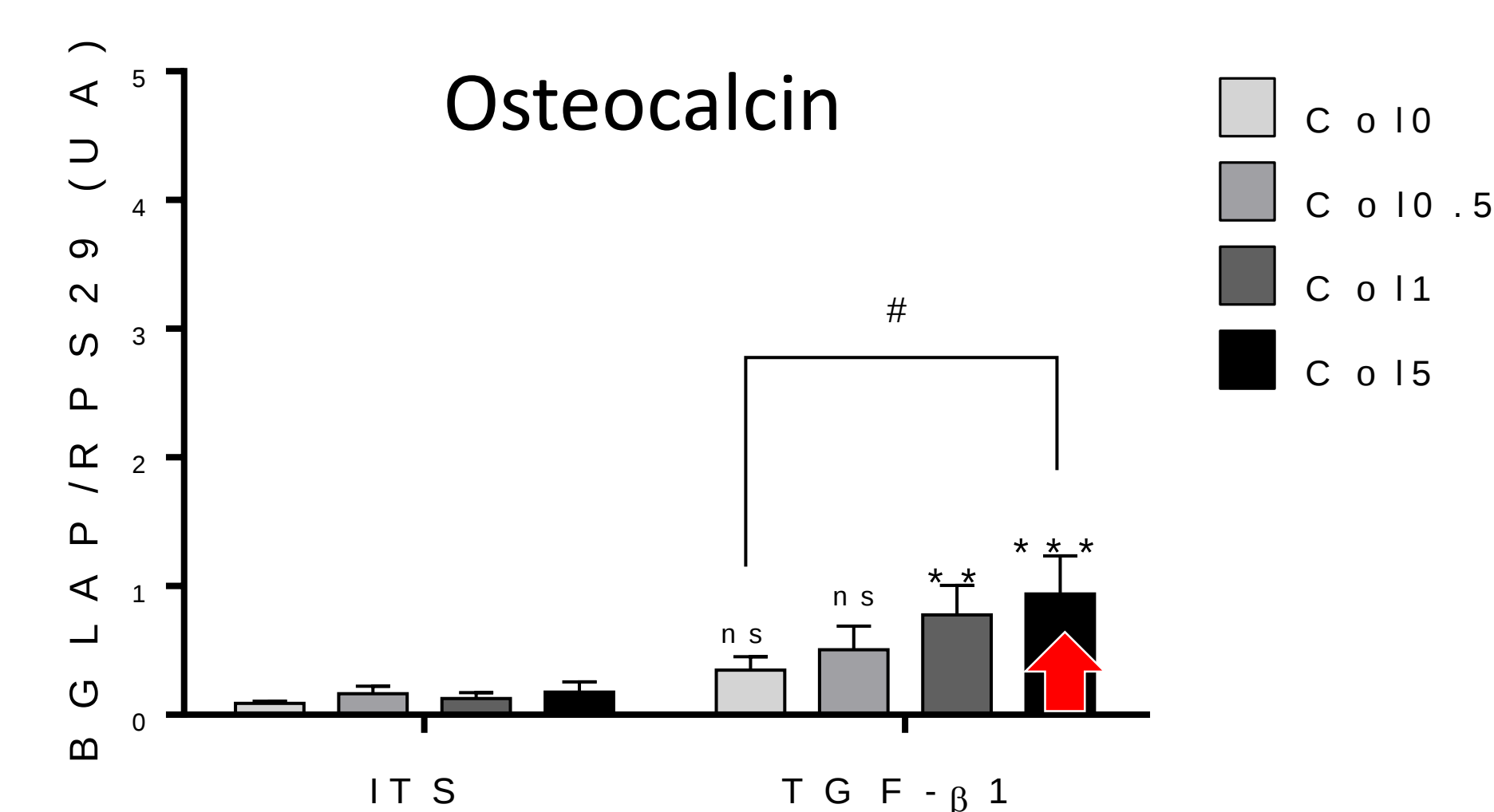
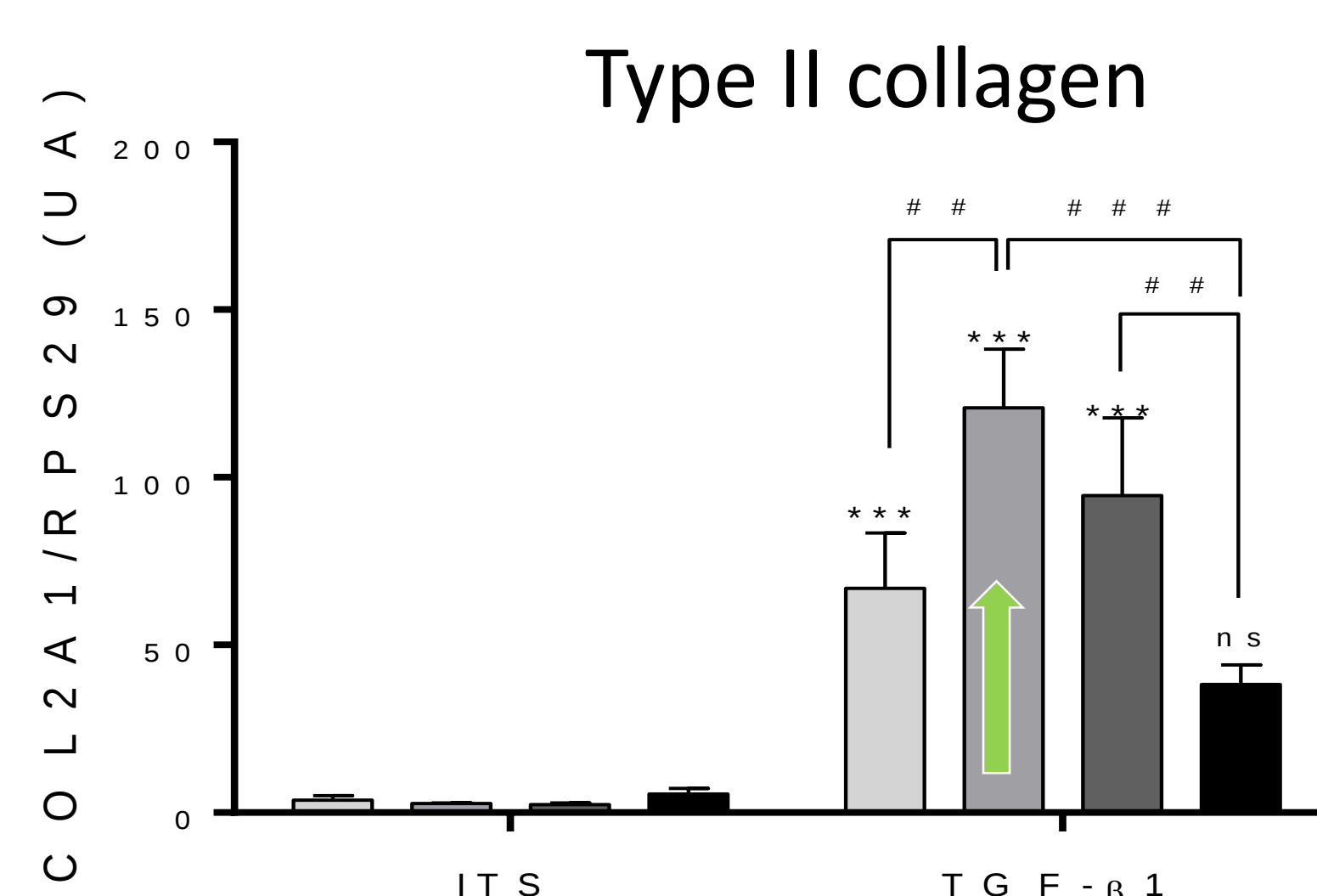
Results

1. Viability assay (LDH)

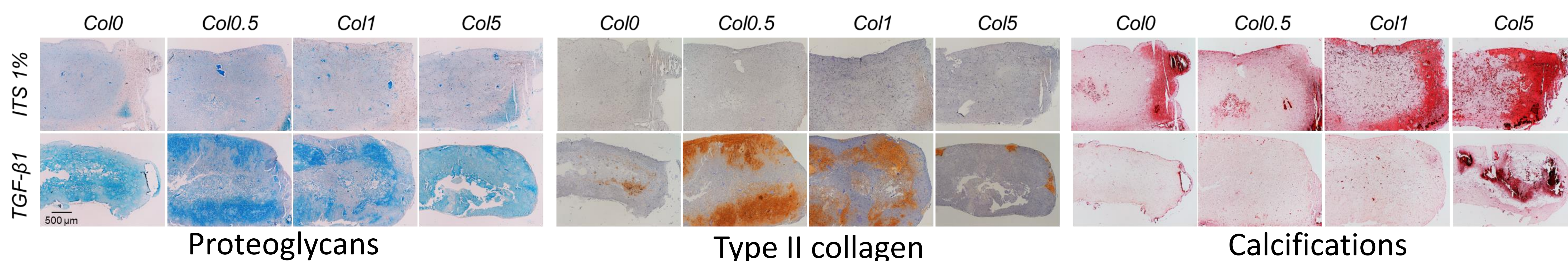


Mean ± SEM. Effect of TGF-β1: * p < 0.05, ** p < 0.01, and *** p < 0.001. Effect of the bioink composition : § p < 0.05, §§ p < 0.01, and §§§ p < 0.001. ; ns: not significant.

2. Gene expressions of chondrogenic and osteogenic markers (Day 28)



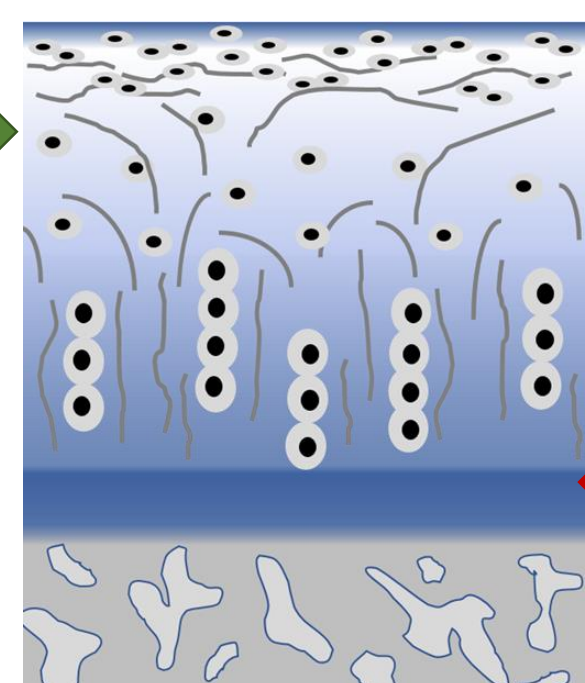
3. Matrix synthesis analyses: Proteoglycans, type II collagen and alizarin red (Day 56)



Conclusions

Low type I collagen addition (0.5 mg) :

- Proteoglycans
- Type II collagen
- Calcifications



High type I collagen addition (5 mg) :

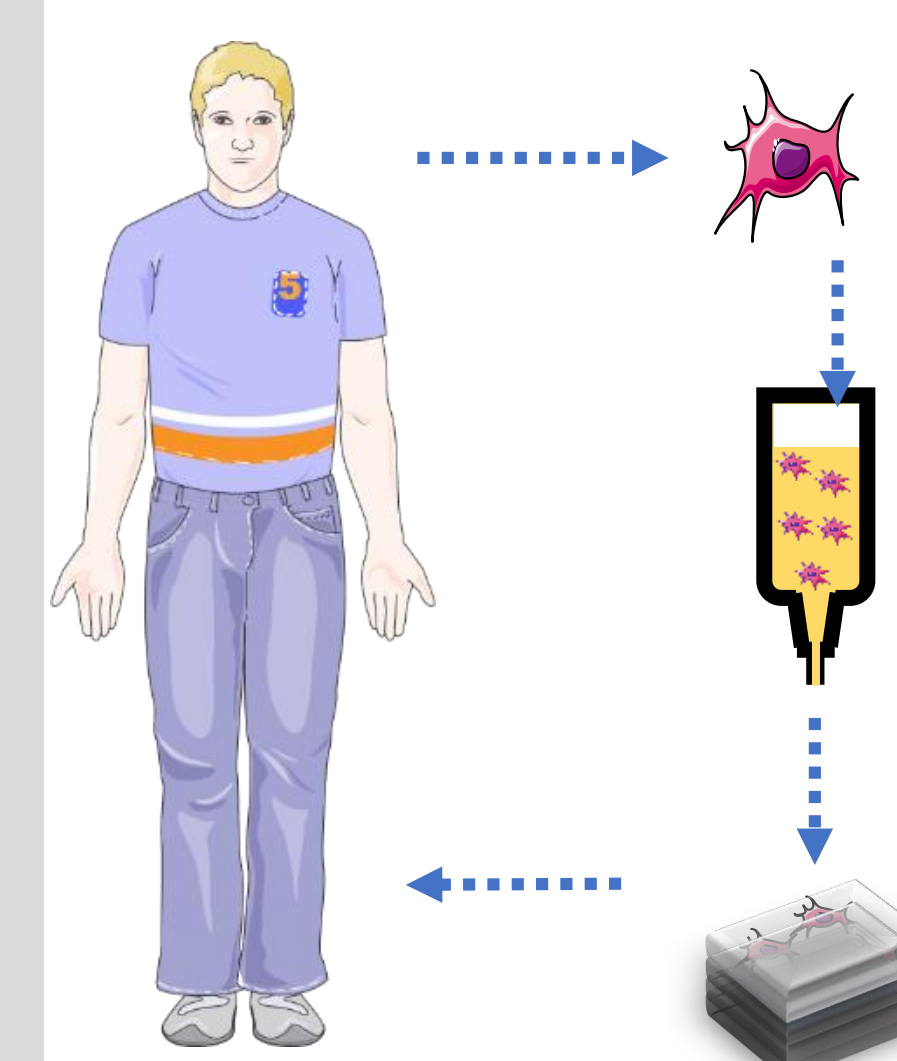
- Proteoglycans
- Type II collagen
- Calcifications



→ Rich matrix adapted to recreate the superficial layers of the cartilage

→ Calcified matrix mimicking the calcified layer of the cartilage

Perspectives



Autologous and personalized regenerative medicine