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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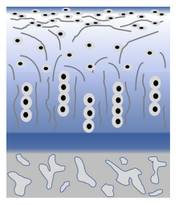
Introduction

Hyaline cartilage



Stratified
Non vascularized
Non innervated

➡ **Limited self-repair properties**

Trauma or overload

Focal lesions

No long-term surgical solution

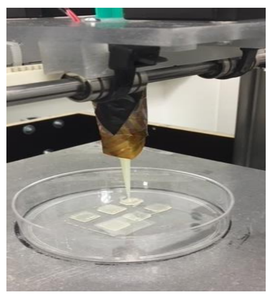
Objectives

Mesenchymal stem cells

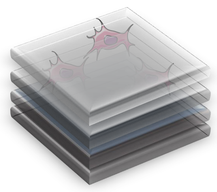
Alginate-based ink

Bioink

Extrusion-based 3D printing method



In vitro production of stratified cartilaginous substitutes



Methods

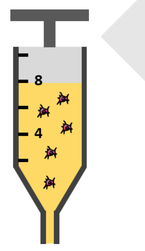
Cellularized bioink

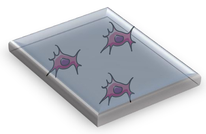
Addition

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 :

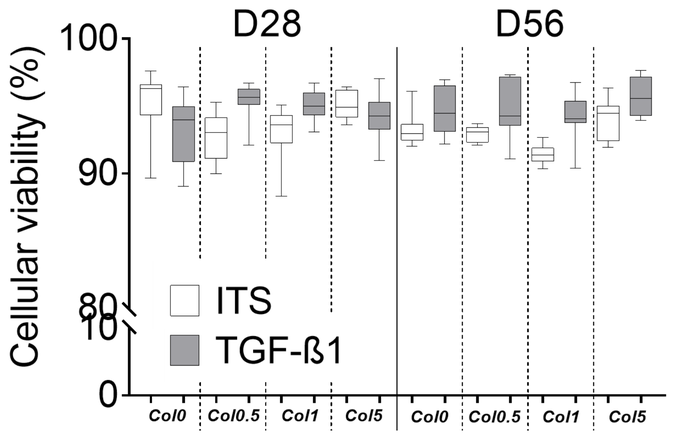
Cellular viability : LDH assay

Genes expressions : RT-qPCR

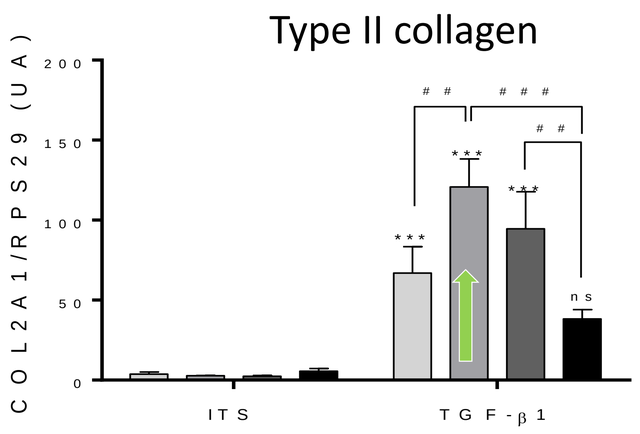
Matrix synthesis : Histological and immunohistochemical analyses

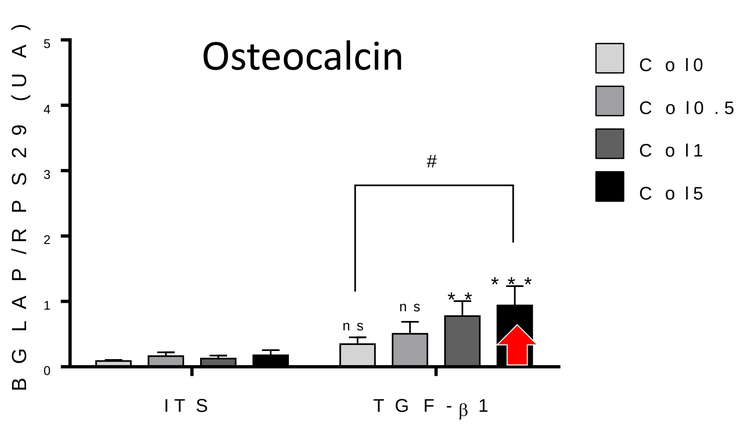
Results

1. Viability assay (LDH)



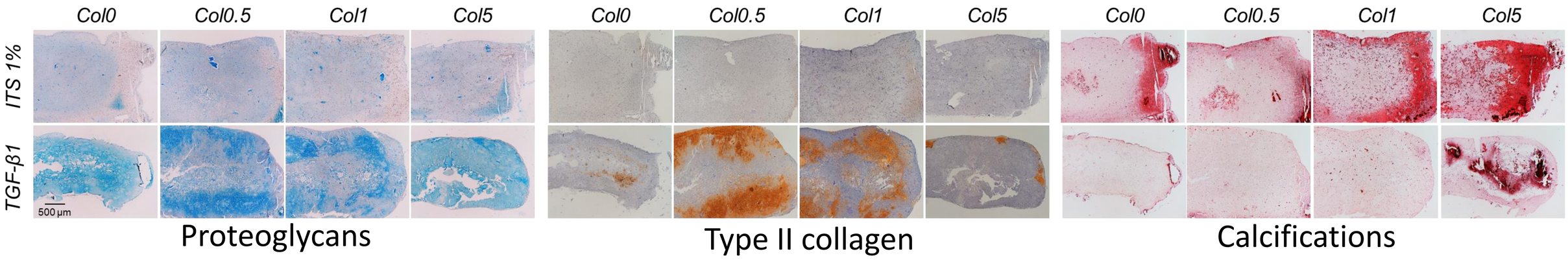
2. Gene expressions of chondrogenic and osteogenic markers (Day 28)





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.

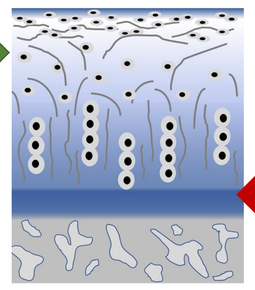
3. Matrix synthesis analyses: Proteoglycans, type II collagen and alizarin red (Day 56)



Conclusions

Low type I collagen addition (0.5 mg) :

- ↗ Proteoglycans
- ↗ Type II collagen
- ↘ Calcifications



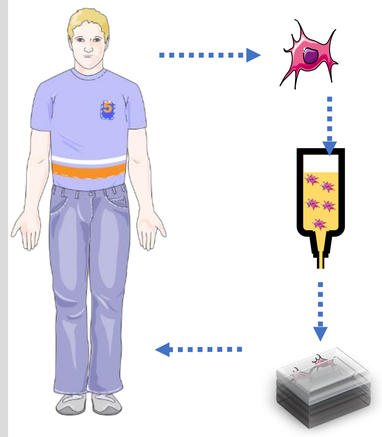
High type I collagen addition (5 mg) :

- ↘ 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

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