

Deformation induced chondrocyte damage

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Deformation induced chondrocyte damage

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1. Introduction

As collaborators in the NIBIB/NIH project ‘Predicting cell deformation from body level mechanical loads’ we are investigating mechanical chondrocyte damage thresholds. Thus, we wish to know how much deformation a chondrocyte can endure, and for how long, before it damages (dies).

2. Methods

Bovine chondrocytes are cultured in 3-D agarose constructs. These constructs are subjected to nonuniform compression at a confocal microscope (figure 3). At the microscope, we can image living and dead chondrocytes with fluorescent CTG/PI staining in time and space [1, & figure 1].

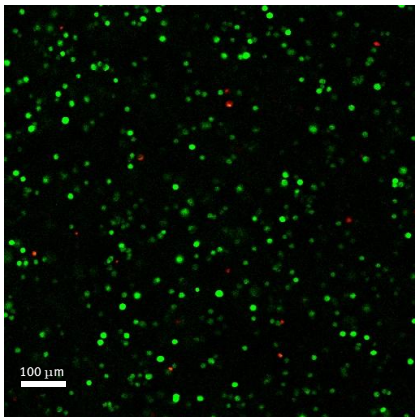


Figure 1: Example of live (CTG, green) – dead (PI, red) staining of the chondrocytes, as imaged with the CLSM.

3. Results

Experiments were performed after 1, 2, and 3 weeks of culturing. Axial compression levels at the centre of the construct were 25 % and 35 %. The fraction of dead cells was monitored before compression (t^-), immediately after compression (t^+)

and after compression for 13 hours ($t + 13$) and 64 hours ($t + 64$) (figure 2).

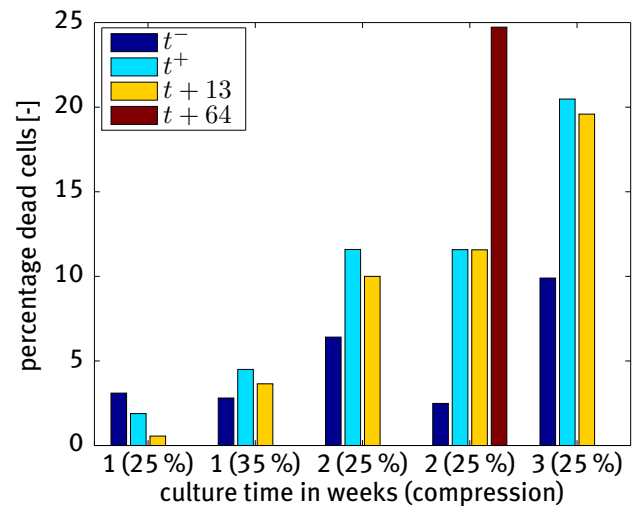


Figure 2: Percentage dead cells at the construct symmetry axis in five experiments before compression (t^-), immediately after compression (t^+), and long after compression ($t + 13$, $t + 64$).

4. Conclusions

- either we can resurrect cells by compression, or we have to critically evaluate our methods and analysis
- longer culture times appear to increase the cells’ vulnerability to deformation
- patience is a virtue if you wish to see substantial chondrocyte death in young samples at 25 % compression

References

- [1] D. Gawlitta *et al.* (2004). Evaluation of a continuous quantification method of apoptosis and necrosis in tissue cultures, *Cryotechnolgy*, 46:139–150.

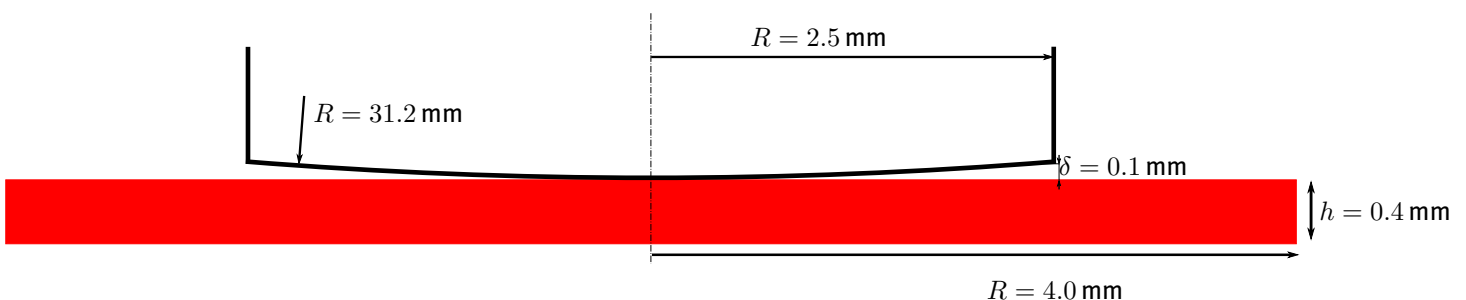


Figure 3: Chondrocyte deformation is induced by deformation of the agarose construct (red). We use an indenter with an spherical end to obtain a variety of deformations in a single experiment. Figure is to scale.