

## **Figure legends**

**Figure 1: A&B)**  $\mu$ CT analysis quantifying volume of contracted hMSC collagen hydrogels. Error bars represent standard error of the mean,  $n \geq 4$ . **C&D)** Bright field imaging of whole gels qualitatively reflects the change in hydrogel volume in the different groups at day 28.

**Figure 2: A&B)** Percentage mineralisation of hydrogels with respect to total gel volume. Error bars = standard error of the mean,  $n \geq 4$ . **C&D)** Image reconstruction of the mineralised volume phase CC (**C**) and CN (**D**). More heavily mineralised volumes of hydrogel are indicated by more solid vs porous grey regions.

**Figure 3: A&B)**  $\mu$ CT analysis of hydrogel Density. Error bars represent standard error of the mean,  $n \geq 4$ . **C)** Representative hydrogel cross sections show density profiles for reconstructed using  $\mu$ CT images. Colour scale bar in **C** represents relative density of the hydrogels in units of mgHA/mm<sup>3</sup>.

**Fig4. A&B)** ImageJ analysis quantifying the average number of cells/mm<sup>2</sup> in each hydrogel. **C&D)** Estimated total number of cells after 28 days in hydrogels fabricated at different CC (**C**) and CN (**D**). Error bars in (**A&B**) represent standard error of the mean,  $n=3$ . Error bars in **C&D**

were calculated via a propagation of error;  $\left( \sum_{n=x,y} \left( \frac{\partial f}{\partial n} \right)^2 * (\Delta n)^2 \right)^{1/2}$  where  $f=x/y$ ,  $x=$  total volume

**Fig5: Fits of the predictive model to the data.** The contracted volume,  $V$ , mineralized volume,  $V_m$ , and percent of mineralized volume were fit to the data as functions of collagen and cell seeding densities. The mean of the squared residuals of each fit is annotated at the top of each plot. Error bars represent standard error of the mean experimental data,  $n \geq 4$ .

**Figure 6: Predictive modelling extrapolation beyond experimental data.** Using the fits of the model from the experimental data, we extrapolated into a larger region of parameter space for the volume, mineralized volume, and percentage of mineralization. Red dots correspond to experimental values plotted in **Figure 5**.