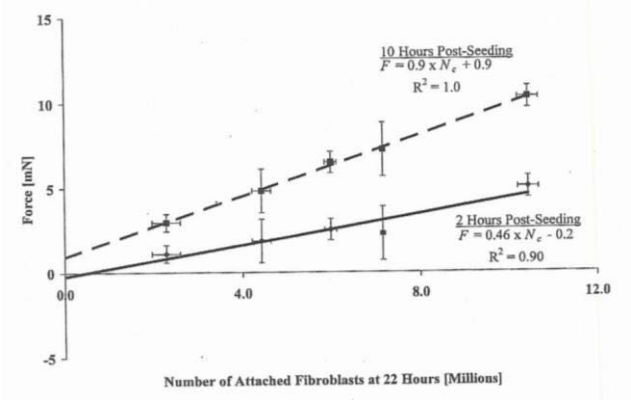
2.785 Homework #8

Model predictions for contractile behavior of cells. The results of a study of fibroblast-matrix interactions in vitro (Freyman et al., 2001) has shown that the force developed by the cells varies as follows with cell density at two time points following cell seeding:



To explain this behavior it has been proposed that the force developed by the cells varies as follows:

$$F_c = N\varphi f_i \qquad \text{[Eq. 1]}$$

In Eq. 1 the macroscopic contractile force vector, F_c, is considered as the product of three contributions: the total number of fibroblasts (FB) in the wound, N; the fraction of cells, φ, bound to the matrix and capable of applying traction; and the average contractile force vector generated per cell, expressed as the in-plane vector component of the force per cell, f_i .

A (20%). Is the model of Eq. 1 compatible with the data? To answer, identify possible basic contradictions (if any) between the model prediction of cell behavior and the data. Explain.
B (10%). In a study of wound contraction of a full-thickness skin wound in a rat model it was observed that contraction did not start until the thickness of contractile fibroblasts at the edges of the wound increased to about 100 μm. After that thickness level was reached, corresponding to an increase in cell density up to a given level, contraction of the wound started. Is this behavior compatible with Eq. 1? Explain.

2.785J / 3.97J / 20.411J Cell-Matrix Mechanics

Fall 2014