MODELLING SKIN HEALING: EFFECT OF CELL TRACTION
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Introduction
Wound healing can be divided in three stages. During the second stage, proliferation, the wound contracts reducing its size. One of the main processes that guide wound contraction is the mechanical behaviour of cells in response to mechanical stimulus. In this work we present a computational model to simulate the contraction of two dimensional wounds. The model considers both mechanical and biochemical factors that affect the evolution of the wound in time.

Methods
This work follows previous models of wound contraction [Javierre et al., 2009]. We study the temporary evolution of different species; fibroblasts, myofibroblasts, a chemical growth factor and collagen, that follow the same conservation law

$$\frac{\partial Q}{\partial t} + \nabla \cdot J_Q = f_Q$$

(1)

where Q denotes the species density, J_Q is the species net flux and f_Q its net production. Moreover, we obtain the matrix deformation from the law

$$\nabla \cdot (\sigma_{ecm} + \sigma_{cell}) = f_{subs}$$

(2)

that includes the stresses created by the matrix σ_{ecm} and by the cells σ_{cell}.

As a difference from previous works we propose that the matrix deformation is the stimulus that determines the ratio of differentiation of fibroblasts into myofibroblasts.

Moreover we consider that stresses exerted by cells σ_{cell} are variable in time and space

$$\sigma_{cell} = p_{cell}(\theta)(n + \xi m) I$$

(3)

where p_{cell} is the traction force per cell, that also depends on the matrix volumetric deformation.

Results
We present the concentration of the fibroblasts along the wound radius in four different moments. We observe that the fibroblasts density in the wound increases with time. The stresses created by cells are guided by this density.

Discussion
In this work we present a wound contraction model guided by the stresses exerted by cells. As a main difference with previous models we propose a mechanosensing and mechano-transductor mechanism based on the matrix deformation. With this mechanism we reproduce the stiffening of the tissue as the collagen density increases [Hinz et al., 2003]. We consider also that stresses depends on fibroblasts and myofibroblasts density, with a law similar to the one proposed by [Murphy et al., 2012]. Moreover, we assume that both fibroblasts and myofibroblasts contribute to the transmission of contractile forces even in the absence of one of them. This effect is not included in most previous models.

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References