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NUMERICAL SIMULATION OF ANGIOGENESIS STIMULATION DURING WOUND HEALING: A PRELIMINARY STUDY

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Summary: Skin wounds are very frequent during human life and may have a negative impact in health. Angiogenesis, the formation of new blood vessels from pre-existent ones, is a fundamental process in wound healing since it allows the reestablishment of the normal blood flow and the sufficient exchange of oxygen and nutrients, essential for cell proliferation and viability. This biological process is stimulated by several chemical molecules such as the vascular endothelial growth factor [1]. This study aimed to construct a computational model to analyze the effect of chemical diffusion in the formation of new blood vessels. The presented model uses meshless methods which allow to discretize the problem domain using only a set of nodes without any pre-established relations. The nodal connectivity is achieved by means of the 'influence-domain' concept. The interpolation functions are constructed using the Radial Point Interpolators techniques, which combines radial basis functions with polynomial functions to obtain the approximation [2]. Since this is a preliminary study, only small-strain elastic-static assumptions are considered. The typical geometry, mechanical properties of the several tissues involved in the simulation and chemical diffusion gradients are obtained from the available literature [3]. The experience acquired with the development of this work permits to better understand the effect of chemical molecules in the angiogenesis process in order to complement experimental research.

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References

[1] Carmeliet P, Jain RK. Molecular mechanisms and clinical applications of angiogenesis. Nature. 2011; 473(7347):298-307.
[2] Belinha J. Meshless Methods in Biomechanics - Bone Tissue Remodelling Analysis, Vol.16. Lecture Notes in Computational Vision and Biomechanics, Springer Netherlands, 2014.
[3] Levy A, Kopplin K, Gefen A. Simulations of skin and subcutaneous tissue loading in the buttocks while regaining weight-bearing after a push-up in wheelchair users. J Mech Behav Biomed Mater. 2013; 28 (2013), 436–447.