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SIMULATING WOUND HEALING WITH VARIABLE INTERCELLULAR CONTACT ADHESION

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Simulating Wound Healing with Variable Intercellular Contact Adhesion

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ABSTRACT

The means and variables through which the cellular wound healing process is affected are fundamental tenets of human physiology whose study has far-reaching, interdisciplinary implications. The contact-dependent adhesive forces present at intercellular junctions are one such variable and understanding their role in supporting or hindering wound healing is of immense interest. To assess the impact of variable cell-cell contact adhesion, we utilized a professional-grade in silico modeling framework called Chaste (Cancer, Heart and Soft Tissue Environment) to run and analyze wound progression simulations. These simulations are underlined by vertex dynamics and a modified force model derived from Nagai, Honda et al. Vertex dynamic modeling involves representing cells as polygonal elements whose vertices may move with our force model defining how vertices favor mechanical equilibrium. To implement these simulations, we created tailored novel C++ test classes in the Chaste environment including simulation libraries to run them. We quantified time-dependent wound healing as a function of variable intercellular contact-dependent adhesion parameter, utilizing custom Python and MATLAB scripts to analyze the simulation output. We discover that enhanced cell-cell contact lengths correlates with accelerated wound area reduction due to increased cell shape changes and movements. Our work demonstrates the potential applications of augmenting the cell-cell adhesive parameters in order to facilitate quicker wound healing.

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