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# A One-Dimensional Model for Contraction in Burn Wounds: A Sensitivity Analysis and a Feasibility Study

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**Abstract :** One of the common complications in post-burn scars is contractions. Depending on the extent of contraction and the wound dimensions, the contracture can cause a limited range-of-motion of joints. A one-dimensional morphoelastic continuum hypothesis-based model describing post-burn scar contractions is considered. The beauty of the one-dimensional model is the speed; hence it quickly yields new results and, therefore, insight. This model describes the movement of the skin and the development of the strain present. Besides these mechanical components, the model also contains chemical components that play a major role in the wound healing process. These components are fibroblasts, myofibroblasts, the so-called signaling molecules, and collagen. The dermal layer is modeled as an isotropic morphoelastic solid, and pulling forces are generated by myofibroblasts. The solution to the model equations is approximated by the finite-element method using linear basis functions. One of the major challenges in biomechanical modeling is the estimation of parameter values. Therefore, this study provides a comprehensive description of skin mechanical parameter values and a sensitivity analysis. Further, since skin mechanical properties change with aging, it is important that the model is feasible for predicting the development of contraction in burn patients of different ages, and hence this study provides a feasibility study. The variability in the solutions is caused by varying the values for some parameters simultaneously over the domain of computation, for which the results of the sensitivity analysis are used. The sensitivity analysis shows that the most sensitive parameters are the equilibrium concentration of collagen, the apoptosis rate of fibroblasts and myofibroblasts, and the secretion rate of signaling molecules. This suggests that most of the variability in the evolution of contraction in burns in patients of different ages might be caused mostly by the decreasing equilibrium of collagen concentration. As expected, the feasibility study shows this model can be used to show distinct extents of contractions in burns in patients of different ages. Nevertheless, contraction formation in children differs from contraction formation in adults because of the growth. This factor has not been incorporated in the model yet, and therefore the feasibility results for children differ from what is seen in the clinic.

**Keywords :** biomechanics, burns, feasibility, fibroblasts, morphoelasticity, sensitivity analysis, skin mechanics, wound contraction
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