

Study and Modelling of the Interaction between Human Soft-Tissue and Filling Materials for the Treatment of Chronic Deep Wounds

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ABSTRACT

With an aging population and rising diabetes and obesity rates, deep wounds represent an increasing public health challenge. Commonly, filling materials or gauzes are used inside the deep wound to support tissue regeneration but their mechanical interaction with soft tissue remains poorly understood. It has been shown that large shear strains inside tissue can damage cells, thus limiting wounds healing [1]. A previous numerical simulation study has proposed to functionally model the presence of the filling material in the wound with uniform pressure applied onto soft tissues [2]. With a sensibility analysis, this study has highlighted the importance of this filling material that explained most of tissue high strains.

In this work, we propose to model more accurately the mechanical behaviour of the filling material inside the wound, assuming a 3D hyperelastic material in contact with wound edges. The wound is a stage III sacral pressure ulcer with a deep open cavity and the filling material is the UrgoClean Rope. Uniaxial tensile and compression tests were performed on this gauze to fit an Ogden hyperelastic constitutive law. Two filling methods were simulated, corresponding to gauze fillings of 80 % and 100 % of the wound cavity.

The study of Green-Lagrange shear strains and contact pressure at the gauze-soft tissue interface show that an 80 % filling rate leads to a more favourable mechanical environment compared to full cavity filling, which provides initial insights for clinical practice.

As a perspective, the implementation of a poroelastic model for the gauze is discussed to account for exudate production by the soft tissues within the wound and its interaction with the filling material and the secondary dressing.

REFERENCES

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