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Internal strains reduction in soft tissues surrounding a pressure ulcer using a new bi-layer dressing

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Introduction: A new bi-layer dressing was designed to alleviate soft tissue under pressure and improve the healing conditions of category-2 Pressure Ulcers (PU). The aim of this study is to assess the ability of this bi-layer dressing to reduce internal strains in soft tissues using a Finite Element Model (FEM).

Methods: A first parametric FEM of the sacral soft tissues (skin and adipose tissues) and the bi-layer dressing was designed. The bone was modeled as a rigid boundary with a simplified spherical geometry and central prominence. A category-2 PU, 1.3 mm deep was added to the model (Figure 1). Hyperelastic constitutive equations were set for soft tissues 1,2 with a stiffening surrounding the PU 3. The dressing first layer, glued with the skin, was modeled as an orthotropic linear elastic compress. The second layer, a compressible honeycombed material with a hole under the PU, was approximated by a compressible Blatz-Ko constitutive material. A rigid plate was added below the dressing to account for a worst-case scenario. A vertical force corresponding to 47 % of a 94 kg subject body weight was applied to the bone. A second parametric FEM without the bi-layer dressing was designed for comparison purpose.

Results: Green-Lagrange shear strains in a Region Of Interest (ROI) were extracted. The volume of soft tissues under a threshold set to 30 % 4 was computed for both models. An increase in quantity of healthy tissues (i.e. strains below 30 %) was noticed when the bi-layer dressing was modeled.

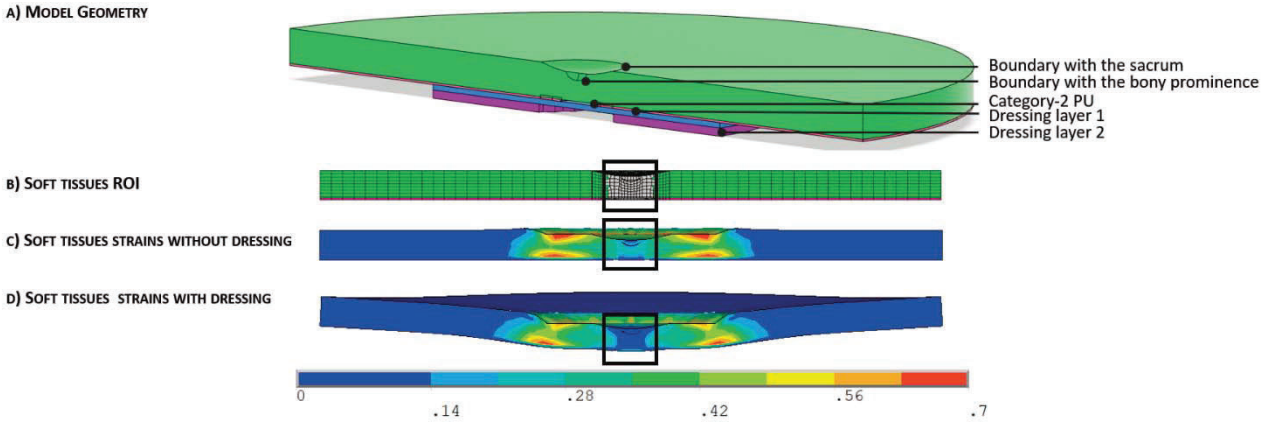

Figure 1 : Parametric FEM of the soft tissues and bi-layer dressing (A). Green-Lagrange shear strains in soft tissues were extracted for both model with and without the bi-layer dressing (C and D). Quantitative comparison of the volume of healthy tissues (with strains below 30 %) was performed in the ROI under de bone boundary (B).

Conclusions: The importance of dressings to maintain a proper biochemical environment for the healing of PU is incontestable. New concepts of dressings may also provide local stress and strain reliefs and create mechanical conditions as less damaging as possible for the tissues.

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