PROTECTING THE SKIN OF PATIENTS WHO ARE POSITIONED SUPINE OR PRONE

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Introduction

Pressure ulcers (PUs), also known as pressure injuries, are soft-tissue damage associated with tissue exposure to sustained deformations and stress concentrations, typically in the vicinity of bony prominences or under a stiff, skin-contacting medical device due to unrelieved bodyweight forces [1-2]. In supine patients with impaired mobility or sensory functions (that are either permanent or temporary), the sacral region is a common site for PUs, including sacral DTIs [3].

Head-of-bed (HOB) elevation is a common clinical practice in hospitals causing the patient's body to slide down in bed because of gravity. This migration effect likely results in tissue shearing between the sacrum and the support surface, which increases the risk for PUs. However, migration-reduction technologies (MRT) incorporated in intensive care bedframes are aimed to aid in minimizing migration and stress levels.

Immersion and envelopment are also two critical benchmarks that determine the comfort and PU risk mitigation levels provided by medical support surfaces as they have a remarkable effect on the stress concentrations near bony prominences [4].

In the case of patients who are proned for ventilation or surgery, PUs may occur in the superficial chest tissues that are compressed between the rib cage and the support surface.

Our goal in this work is to present several methods of protecting the skin of patients who are positioned supine or prone and to evaluate their ability to lower the risk of PUs by means of finite element (FE) modeling.

Methods

We developed three-dimensional anatomically-realistic FE modeling frameworks of the human buttocks, as well as of the whole torso, both include the inner organs and tissues to simulate various scenarios of PU development in patients who are lying supine or prone, quantifying the effectiveness of each method in dispersing tissue stress concentrations near vulnerable tissue.

First, we modeled the effect of using MRT during HOB elevation, on the levels of shear stresses in the tissues. Second, we compared the risk of developing a sacral PU while lying supine on a regular foam mattress with respect to lying on a specialized, minimum tissue deformation mattress (MTDM) which closely conforms to the body contours. Third, we investigated the biomechanical efficacy of a dressing with a soft cellulose fluff core in protecting proned surgical patients from chest PUs occurring on the operating table.

Results

The modelling showed that the MRT system can reduce migration in bed, and therefore – minimize the risk for sacral PUs. In addition, we revealed that MTDM provides longer safe times for supine support in comparison to a regular flat mattress. For the prone position, we have shown that prophylactic dressings dispersed elevated soft-tissue stresses, protecting the skin from PUs.

Discussion

The quantitative methods presented here points to the strong prophylactic benefits in: *(i)* minimizing the migration in bed to reduce the biomechanical risk for PUs, *(ii)* alleviation of localized, sustained stress concentrations through good immersion and envelopment of the support surface *(iii)* using soft cellulose fluff core dressings for pressure ulcer prophylaxis, including during surgery for proned patients.

References

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Keywords

Pressure ulcers, Soft Tissues, Supine, Prone, Finite Element,