Rehabilitation Engineering & Applied Research

3-DIMENSIONAL PHANTOM BUTTOCKS TISSUE DEFORMATION ACROSS CUSHIONS

Sharon Eve Sonenblum, PhD
Stephen Sprigle, PhD, PT

Background

- Pressure ulcers are a leading secondary complication of spinal cord injury.
- Internal tissue deformation resulting from external interface pressure is believed to be the primary biomechanical factor responsible for pressure ulcer development.

Methods

Model

- Embedded molded pelvis and femurs (3B Scientific)
- Gel-based buttocks and thighs (Dragon Skin FX-Pro®, Smooth-On, Inc., Easton, PA)

Data Collection Protocol

- Siemens Trio 3T MRI scanner
- Coronal, T1 images, 4mm slice thickness
- 4 Loading conditions/surfaces pictured to the right: unloaded reference, HR45 foam, a Jay Extreme cushion, and a rigid surface
- 58.4 kg were applied on top of the buttocks and thighs to simulate a 70kg person

Analysis

- Mimics (Materialise, Inc.)
- Registered pelvis to unloaded reference
- Identified peak of the ischial tuberosity and tissue thickness below the ischial tuberosity.

Goals

In order to provide effective interventions to prevent PU development, we must:

- *Current Study*: Demonstrate that 3-dimensional measurements of a phantom buttocks tissue deformation could be collected from MRI data.
- *Long term*: Understand how individuals' buttocks tissue responds to loading when seated on different commercially available cushions.

Results: Tissue Thickness & Deformation at the Ischial Tuberosities

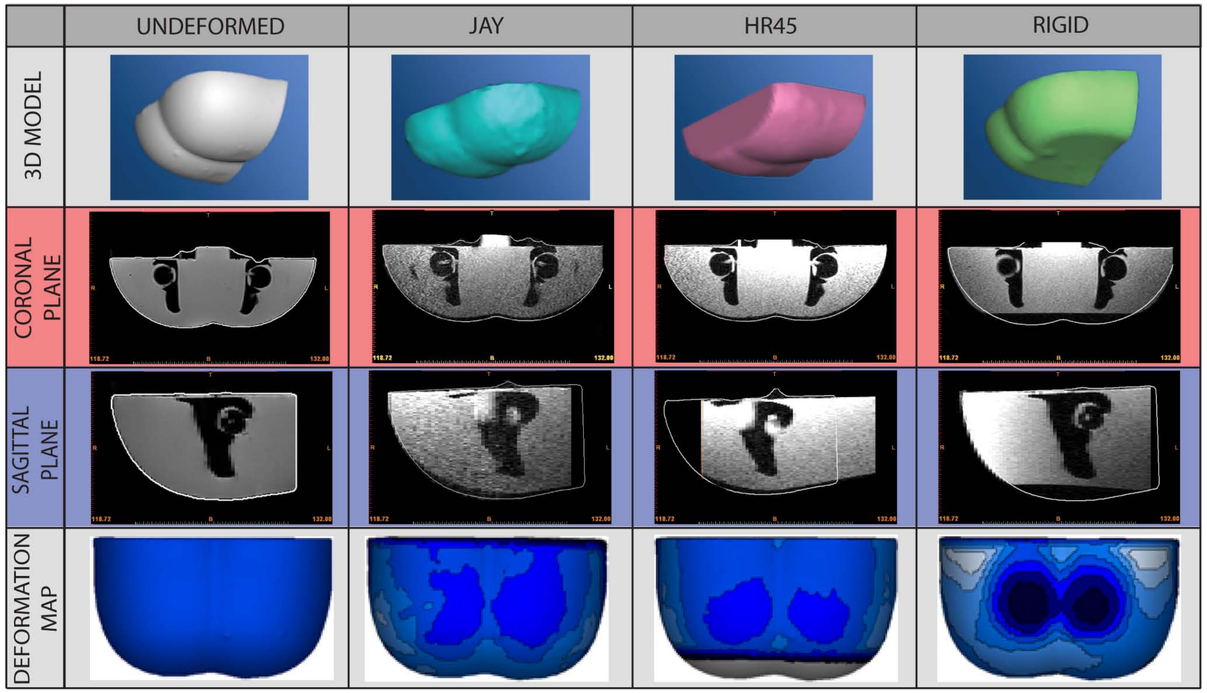
Cushion	Thickness (mm)	% Deformation
Unloaded	22.3	0%
Jay Extreme	21.2	5%
HR 45 Foam	17.7	21%
Rigid	6.0	73%

Results: 3D

Row 1: 3D rendering of model surface.

Rows 2-3: Contours of the unloaded buttocks compared with the MRI of the deformed buttocks.

Row 4: Deformation maps, where darker colors correspond with greater deformation. On the rigid surface there was a steeper gradient of deformation near the ischial tuberosities than on the Jay Extreme and HR45 foam.



Conclusions

- Differences do exist in the deformation of buttocks tissue across cushions, with greatest deformation on a rigid surface.
- MRI is a suitable methodology to analyze 3-dimensional buttocks deformation.
- More study is needed to determine how the differences in deformation will impact pressure ulcer development.

Acknowledgements

We would like to thank Nytavia Wallace and CABI for their role in collecting the MRI data.

This work was completed as part of the Mobility RERC, which is funded by the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education under grant number H133E080003. The opinions contained in this poster are those of the grantee and do not necessarily reflect those of the U.S. Department of Education.

mobilityRERC

Georgia Institute of Technology