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Measuring the impact of cushion design on buttocks tissue deformation: An MRI approach.

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Abstract

AIM: To establish a research approach for describing how different wheelchair cushion designs impact buttocks tissue deformation during sitting.

MATERIALS AND METHODS: The buttocks of 4 individuals with spinal cord injury and significant atrophy were scanned sitting in a FONAR Upright MRI. Scans were collected with the individuals' buttocks fully suspended without pelvic support, and seated on 3 different commercially available wheelchair cushions. Multi-planar scans were analyzed to provide 3D renderings and measurements of tissue thickness and shape.

RESULTS: Bulk tissue thicknesses at the ischium, which rarely included muscle, were reduced by more than 60% on enveloping cushion designs studied (i.e., Roho HP and Matrx Vi), and more variably (23-60%) on an orthotic off-loading design (i.e., Java). Adipose was typically displaced posterior and superior from the unloaded condition, with more lateral displacement on the Roho HP and Matrx Vi and more medial displacement present on the Java. Large changes in angle at the sacro-coccygeal joint indicated significant loading on the region. Deformation at the greater trochanter was more consistent across surfaces. Greater interface pressures tended to be associated with greater deformation, but the relationship varied by individuals and was highly non-linear.

CONCLUSIONS: The buttocks in this study all deformed significantly, but at different locations and in different manners across all 3 surfaces. Attention needs to be paid to the regions of greatest deformation. A future metric of shape compliance should consider cushion performance at all high risk regions, and changes to the amount and shape of tissue in the regions of interest.

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KEYWORDS: Buttocks; MRI; Multi-planar; Pressure ulcer; Tissue deformation; Wheelchair cushion

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